ROADS AND STREETS

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This Extra Width Is to Make Room for a 76 Ft. Boulevard. 40 Ft. Beach Lots on the Left Recently Sold for as Much as $20,000 Each.

Reconstructing an Important CALIFORNIA HIGHWAY

Widening 4.2-Mile Section of Road in Los Angeles County Required 200,000 Cu. Yd. of Excavation Per Mile, Which Had to Be Handled Without Interrupting Traffic

By J. M. LACKEY

RECONSTRUCTION of a section of California State Highway, in Los Angeles County, north of Santa Monica, involving the removal of 800,000 cu. yd. of earth and rock and the placing of 45,000 tons of asphaltic concrete pavement—the job to be completed in six months—is the undertaking, now well under way, of S. H. Palmer and J. P. Holland, Inc., contractors. Into the bargain, they must provide safe passage to traffic, with the least possible inconvenience, on the most heavily traveled road in the state system.

Only a few years ago the coast, immediately north of Santa Monica, was comparatively inaccessible. El Camino Real of the Padres turned inland to avoid the precipitous and rugged coast. An occasional horseman, or homesteader with wagon team, traveled along the beach at low tide (weather permitting), fortunate if he accomplished a few miles a day.

A narrow earth road was later built, a few miles up the coast from Santa Monica, encouraging many to build summer homes and beach cottages.

In 1916, the State of California adopted this location for a state highway and began the construction of a 20 ft. pavement, which, at the time of its completion in 1928, to a junction near Ventura with the San Francisco highway, was the most heavily traveled road in the state system and inadequate to meet the heavy demands placed upon it. Now, a new and wider highway is being built over the old.

A few miles north of Santa Monica, 4.2 miles of modern 76 ft. boulevard is being constructed, cutting across curves, hewing away whole mountain sides. The work involves many spectacular features.

Beaches of almost fabulous value (this being one of California's most famous playgrounds) make necessary the widening and straightening be done on the mountain side of the highway. The mountains (an upheaved sedimentary coastal plain—made precipitous by ages of wind and wave) sometimes temperamentally refuse to stand the attacks of man with his power shovels, and come tumbling down in great masses to delay the work and annoy the traveler.

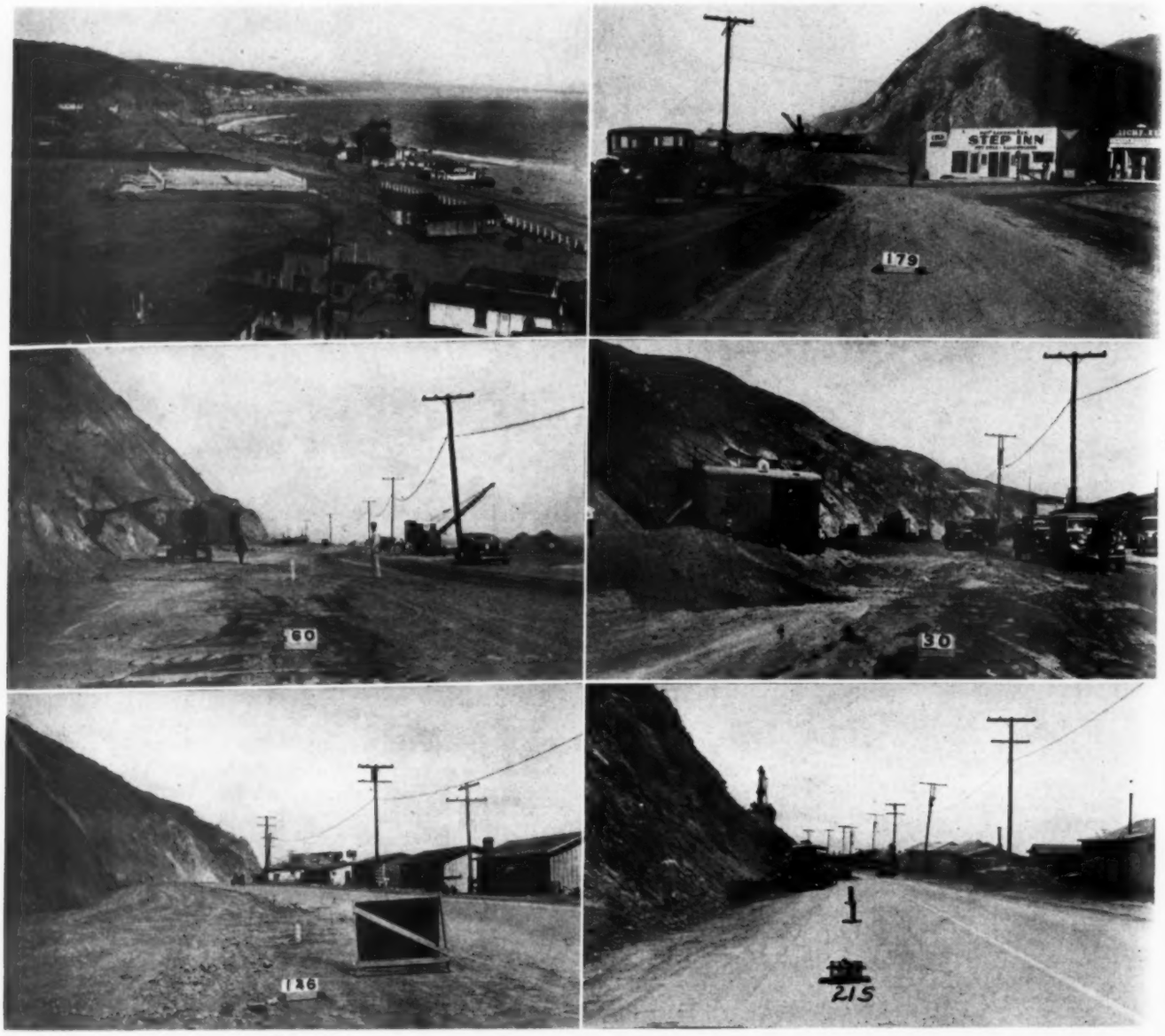
The grading work is, in reality, a huge resloping job—there being no thorough cuts. The road must be kept open for traffic at all times and finished shoulders made smooth, immediately, so bathers may park their autos without inconvenience. Flagmen are provided, where needed, to direct traffic safely and quickly.

On the grading work, now practically completed, a

large force of men and machines has been kept busy 17 hours per day—working one 5-hour and two 6-hour shifts. Equipment used includes five large capacity shovels; 11 caterpillar-type tractors with bull-dozers; 38 large trucks of 5 to 7 cu. yd. capactity, the outfits turning out from 11,000 to 14,000 cu. yd. of roadway excavation per day. A crew, including 15 shovel operators, 36 tractor operators, 96 truck drivers, and 40 to 50 flagmen, was required.

Removal of material from high slopes was generally done with bulldozers or power shovels climbing and casting, or by blasting in rocky sections. The road is practically all in cut section, so disposal of excess excavation was a serious problem. One solution was to haul it out to sea in barges, the other (and the one subsequently adopted) was to raise the grade over the Topanga Creek basin, and the level of the whole basin 25 to 30 feet—not an easy solution, since the valley was well covered with houses, with no place to put them temporarily. A section was finally cleared out and filled to grade and many of the buildings moved on it, while the remainder of the fill was constructed.

Knowledge of soil compaction, the result of years of study by State highway research engineers and others, was put to practical use in fill construction. A laboratory was maintained by the highway department on the job, with a competent engineer in charge. Many tests were made daily: (1) To determine proper amount of moisture for maximum compaction. (2) Check tests on amount of water used, and (3) Check tests on compaction obtained. Water used in the fill was metered. The amount necessary was determined by the laboratory engineer and application made under the surveillance of an inspector constantly on the job. Very successful results were obtained. Other tests were made to determine suitability of soils for subgrade and oil shoulders.



Upper Left: Construction of Topanga Creek Fill. Forty or Fifty Beach Cottages Were Removed to Make Room for This Fill, Wherein 325,000 Cu. Yd. of Excavated Material Were Spread, Watered and Rolled in 8 In. Layers. An Equal Amount Was Disposed of Upstream. The Old Road Is Shown on the Right. Upper Right: Showing How Curves Are Eliminated. The "Step Inn" Must Soon Step Out. Middle Left: The Cut on Left Center Is 165 Ft. High. Here Eight Small Curves Have Been Eliminated. Middle Right: Traffic Is Handled with Safety and Very Little Inconvenience. No Detours Are Available. Bottom Left: This Looks Like a Quiet Day Here, But on Sundays and Holidays Traffic Is Very Heavy and Cars Are Parked Thickly Along Both Sides of the Road. Middle Right: Pole Lines on the Right Will Be Moved to a Permanent Location Along the Bluffs on the Left Upon Completion of the Highway.

A 2-ton asphalt paving plant has been erected on the job. The power is furnished by a Fairbanks Morse 360 hp. Diesel electric power plant. Aggregates are fed to the plant with a belt and tunnel system.

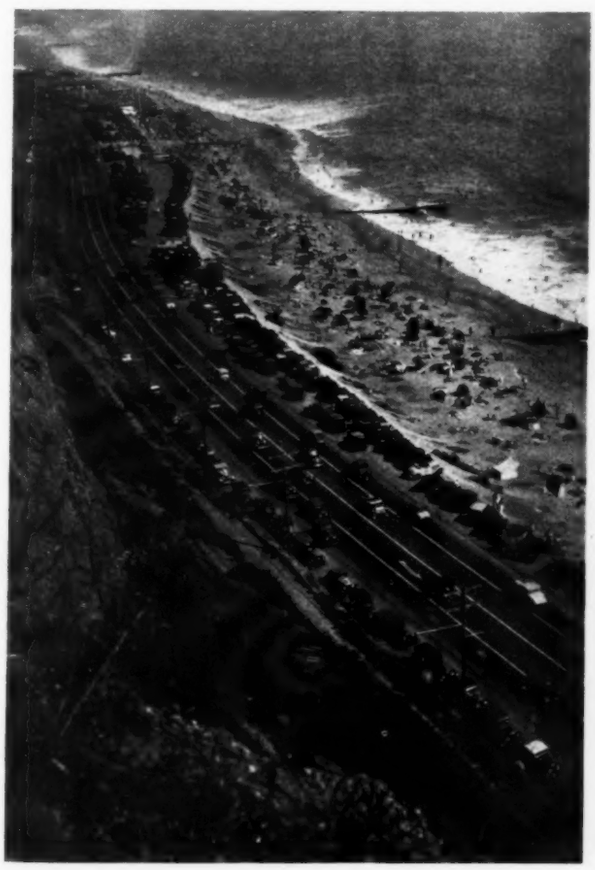
The 40 ft. pavement, being constructed in two 20 ft. sections, is laid in three courses: A 3-in base course; a 2 in. leveling course; and finally a 2 in. wearing surface. Pavement thicknesses is 0.6 ft., thickened to 0.75 ft. at the edges. Timber side forms 3 in. by 9 in. are used. The successive layers of asphaltic mixture are spread and raked with a Lakewood asphalt finishing machine. Two 3-wheel, 12-ton rollers and three 8-ton tandem rollers are used to compact and iron out the hot mixture. An average of 900 tons is laid per 8-hour day.

The most advanced engineering methods are practiced, in design and control of mixing and laying. At the plant, two well trained and experienced assistant engineers are at work, constantly testing for improvement in design and plant performance; while, on the street, other assistants carefully check the finished surface for irregularities, which are removed by cross rolling. The result is a durable non-skid surface of remarkable smooothness.

Of the many problems faced by the contractor, the too numerous cottages was in the lead. Only by the splendid cooperation on the part of several house moving contractors was much delay avoided. Landslides were also a serious problem—four major slides already having occurred, amounting to over 200,000 cu. yds.

Principle equipment in use includes the following:

3 Bucyrus Erie 1½ yd. gas shovels.
2 Northwest 1¼ yd. gas shovels.
1 70 hp. Caterpillar Diesel tractor.
1 80 hp. Cletrac tractor.
1 70 hp. Allis Chalmers tractor.
4 60 hp. Caterpillar tractors.



Ordinary Sunday Traffic on an Adjoining Section Recently Completed

Shoulder Widening for Traffic Between Pole Line and Ocean. Removing a 165 Ft. Slice from the Mountain Side

4 35 hp. Allis Chalmers tractors.
8 7 yd. Fageol trucks.
14 5 yd. International trucks.
16 6 yd. Sterling trucks.
2 Austin 3-wheel, 12-ton rollers.
3 250 c.f.t. Ingersoll Rand compressors.
1 2-ton Standard asphalt plant.
1 360 hp. Fairbanks Morse Diesel electric power unit.
1 Lakewood asphalt spreading and finishing machine.
2 Austin 4-cylinder, 3-wheel, 12-ton rollers.
2 Buffalo Springfield tandem 8-ton rollers.
1 Gallion tandem 8-ton roller.

The force employed ranges from 350 to 450 men. Certain hand labor stipulations in the contract are responsible, in part, for the large force.

S. H. Palmer and J. P. Holland, Inc., of San Francisco, are the contractors. J. P. Holland, Jr., is superintendent and H. S. Glackin, contractor's engineer.

C. H. Purcell is the state highway engineer; S. V. Cortelyou, district engineer; A. N. George, construction engineer and J. M. Lackey, resident engineer.

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Creed for Roadside Improvement

E. Russell Bourne of New York, in his recently published "Creed for Conservation," stressing roadside improvement, makes the following points, according to Civic Comment:

(1) The appointment of a first-class landscape architect to serve on every highway commission. (2) The broadening of the law of eminent domain, under which land is condemned by the highway commissioner, to permit free purchase of land for highway purposes. (3) Widening of rights of way, known as freeways, for all main arteries of traffic. (Through state ownership of the right of way, it is proposed to control gas stations, lunch stands, billboards, placement of electric light poles, proper planting of trees, and conservation of trees and wild flowers.) (4) Planning of roads to increase scenic beauty. (5) By-passes for towns and villages to provide peace, quiet and safety. (6) Parkway development of main arteries of traffic with careful landscaping near cities and preservation of natural beauties outside urban areas. (7) Capitalization of highways as scenic assets of the State and community, to increase real estate values, rather than destroy values.

Showing How a Very Low Bid Does Not Always Mean a Heavy Loss

AN EXAMPLE of how an extremely low bid does not always reflect a heavy loss to the contractor, provided he uses his imagination and couples it with sensible promotion, was shown on Highway 42, Milwaukee County, Wisconsin, awarded to the Frank D. Hayes Company of Janesville, Wis., Sept. 9, 1932.

What the Job Included.—This road job involved the removal of the old 18 ft. concrete slab and the replacement with a 30 ft. slab for a distance of 4.6 miles between the south city limits of Milwaukee and the north city limits of South Milwaukee through the city of Cudahy.

The major quantities on the job were:

13,500 cu. yd. of earth excavation.
52,000 sq. yd. of old pavement removal.
27,500 sq. yd. of shoulders.
84,000 sq. yd. of new pavement.
446 cu. yd. of masonry wall.

besides numerous minor items such as curb and gutter, culverts, man-holes, catch basins, etc.

The bid of the Hayes Company was $166,958.44, and was about $14,000 lower than the second low bidder. Although this company has been building roads for more than ten years, everyone was sceptical of their ability to perform this work without serious loss.

The Old Pavement Removal Item.—The item on which the chief difference occurred was the removal of the old pavement. The Hayes Company's bid on this item was 27 ct. per square yard, while that of the second low bidder was 60 ct., a difference of more than $17,000.

The special provisions required that while the old slab could be broken up mechanically, it must be loaded by hand labor. To add to the difficulty a Milwaukee park bordered the east edge of the road while the west side was built up with homes. The road for the most part was flat, preventing the disposal of the concrete in shoulders or fills. It looked as though the broken concrete would have to be hauled a long way to a dump.

Machine Used for Breaking Concrete

Here James Gough entered the picture. He furnished trucks for the hauling at a low price because he was able to crush this material and sell it to the city of Cudahy for street surfacing. Mayor Joseph Wagner, City Engineer Frank B. Schade, and Street Commissioner Robert H. Mueller were quick to see the economy of this proposition because this material was placed

Plant Used for Crushing Broken Concrete. The Men Are (Left to Right): Frank D. Hayes, Contractor; Joseph Wagner, Mayor of Cudahy, Wis.; James Gough, Contractor; Robert H. Mueller, Superintendent of Streets; Frank B. Schade, City Engineer of Cudahy.

Loading Broken Concrete to Haul to Stock Pile

on the streets at a cost little higher than the freight for crushed stone.

Breaking Up and Utilizing Old Cement.—The old pavement was first broken with a machine furnished and operated by the Chicago Concrete Breaking Co., which consisted of a large truck on the rear of which was mounted an air compressor driving a hammer in guides, which swung on a turn table for a full half circle. This machine was used in preference to a heavy ball on a crane because it broke the concrete in pieces without crushing, in sizes that were easily handled by men. After the concrete was broken a Killefer rooter was used to root the pieces up. With this method 30 men were able to average 1,800 sq. yd. per day.

The broken chunks were hauled and dumped over a steep embankment at the bottom of which Gough had placed his crusher. The streets to be surfaced were first levelled with a Wehr grader, the broken and crushed concrete was spread about 3 in. thick and rolled. The surface was then oiled and sanded. These streets have been under traffic for about four months and in spite of numerous heavy rains, show no wear and no chuck holes have appeared.

Old Concrete Used in Masonry Wall.—Besides using the broken concrete for street surfacing, the plans called for building a 446 cu. yd. masonry wall across a ravine 30 ft. deep. At this point a creek parallels the road for 250 ft. and passes under the road through a 6 ft. culvert. It was impossible to make an earth fill for shoulders as the toe of the slope would fill the channel of the creek. Originally it was planned to carry this wall up to the level of the pavement, but when Resident Engineer Edward Plautz saw how well it looked, he called Joseph Stransky, and Albert Bleck, chief and assistant engineers of the highway division, and they decided to eliminate the cable guard fence and build a parapet wall 3 ft. above the pavement level.

Report on Test Beams Made from Reclaimed Concrete.—Utilization of this broken concrete became a hobby and M. O. Johnson, engineer in charge of testing materials on the job, made a number of test beams on which he reports as follows:

RECLAIMED, CRUSHED CONCRETE AS COARSE AGGREGATE

A series of experiments were performed in conjunction with the construction of the Sheridan Road, S. T. H.—42—Milwaukee County.

It was desired to determine the strength that reclaimed concrete would develop in a concrete mix when used as coarse aggregate. The same cement content was used in making the reclaimed concrete beam as was being used in placing the concrete for the new road using gravel.

Three sizes of aggregate were first screened out according to Wisconsin Highway Specifications. Everything passing the 2½ in. circular screen and retained on the 1½ in. screen was considered and used as the large size aggregate. The medium size aggregate consisted of everything passing the 1½ in. screen and retained on the ¾ in. screen. The small size aggregate was

Rubble Masonry Wall Built of Old Concrete from Pavement. John Zanco, Foreman of Wall Crew, Is Second Man at Right.

that portion of the crushings being retained on the ¼ in. screen and passing the ¾-in. screen. These various sizes were incorporated in the mix, using 35 per cent large, 40 per cent medium and 25 per cent small to approach as nearly as possible the straight line graduation curve.

Talbot's method of design was employed in combining the mix using a $\frac{B}{Bo}$ factor of 0.85 for casting one set of concrete beams, and a cement content of 1.5 bbl. cu. yd. In making the

Street with Crushed Concrete Before Oiling.

Street with Crushed Concrete After Oiling.

second set of concrete beams a $\frac{B}{Bo}$ factor of 0.75 and a cement content of 1.35 bbl. cu. yd. was used. In both cases torpedo sand was used as the fine aggregate. The second set of beams were made under the technical supervision of Mr. W. E. Patitz, Materials Engineer, Wisconsin Highway Commission, Division No. 2.

The following data were gathered:

Set No. 1
Concrete Characteristics

$\frac{B}{Bo} = 0.85$

Cement Content 1.5 bbl./cu.yd.
Modulus of Rupture lb./sq. in.

Beam No.	7 days	28 days
1	595	885-875
2	615	950-780
3	550	875-900
4	540	815-745
5	490	740-800

Average 7 day strength—558 lb./sq.in.
Average 28 day strength—836.5 lb./sq.in.
Average increase—50%.

Concrete was harsh, unworkable and impractical for extensive use.

Set No. 2
Concrete Characteristics

$\frac{B}{Bo} = 0.75$

Cement content 1.35 bbl./cu.yd.
Modulus of Rupture lb./sq.in.

Beam No.	7 days	28 days
6	560	655-650
7	570	695-695
8	570	740-740
9	585	720-600
10	560	630-680
11	495	735-715

Average 7 day strength—557 lb./sq.in.
Average 28 day strength—688 lb./sq.in.
Average increase—23.5%.

This concrete was very workable and suitable for extensive use.

After the seven day breaks had been made it was noticed that those beams containing a higher cement content and a lower sand, cement ratio possessed strengths almost equal those beams having a lower cement content and a higher sand, cement ratio. It was assumed that the strength of the old concrete had been completely utilized in seven days, and that very little increase in strength could be expected at 28 days. The completion of the experiment conclusively proved that these assumptions were wrong.

The purpose of the experiment was to gather sufficient data to substantiate the use of reclaimed concrete in building new highways. It is believed that the disposition of old concrete will eventually present itself as a problem especially in metropolitan areas where little grade change is made and consequently a minimum of fills sufficiently large enough to bury old concrete. Incorporating reclaimed concrete in new highways will serve a dual role, eliminating the necessity of a site for waste, and serving as a portion of the concrete for the new highway.

M. O. Johnson,
Inspector, Wisconsin Highway Commission.

Bulk Cement Platform.

Left to Right: Frank D. Hayes, President, Frank D. Hayes Co.; M. O. Johnson, Materials Inspector, Wisconsin Highway Commission; Wm. B. Miller, Secretary, Frank D. Hayes Co.

New Pavement Construction.—The building of the pavement was of interest only in that it was built the full 30 ft. width, at one time using a Lakewood 30 ft. finishing machine, and Heltzel 30 ft. joint machines which is a new method around here. Formerly the 30 ft. roads were built in 20 and 10 ft. lanes.

The price on the concrete removal would be too low if the road were in a rural district where the concrete could not be crushed and used or where the price of other aggregate were low enough to eliminate any great saving.

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Director of Purchases Appointed for Tennessee Valley Authority

The Tennessee Valley Authority, Washington, D. C., has appointed Charles H. Garity of Catonsville, Maryland, its director of purchases and procurement. Mr. Garity has had a wide experience in the hardware, mill supplies and general machinery lines. Born in New York City, he attended the local public schools. Before the World War, in which he served as procurement officer in the hardware and metals division which later became the General Supplies Division of the Quartermaster Corps, terminating his service with the rank of captain, Mr. Garity was connected with Sweet's Catalogue of Engineering and Dodge Reports. He was subsequently buyer and manager for the American Wholesale Corporation of Baltimore and, more recently, was connected with the Arundel Corporation of the same city on the Safe Harbor hydroelectric project as purchasing agent and office manager.

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CONNECTICUT REQUIRES FINANCIAL STATEMENT.—A "Financial Statement" as of Jan. 1, 1933, or later must be filed in the office of the Engineer of Contracts of the State Highway Department before proposals can be given out for any work to be let.

Code of Fair Competition for the Construction Industry

A COMMITTEE of the Construction League of the United States, which is composed of representatives of the major national associations in the construction industry, has submitted to the N. R. A. a master code for the entire construction industry. Upon adoption it will become the basic code for all construction. Hearings on the code began Sept. 6. Provision is made by this basic code for supplemental codes covering the various divisions of construction. The proposed code for General Contractors is given elsewhere in this issue. The code submitted by the Construction League follows.

To effectuate the policy or policies of Title I of the National Industrial Recovery Act during the period of the emergency, to induce and maintain the united action of all elements of the Construction Industry under adequate governmental or private sanctions and supervisions, to eliminate unfair competitive practices and to advance the public interest, to reduce and relieve unemployment, to improve standards of labor and living and otherwise to rehabilitate the Construction Industry, the following provisions are established as a Code of Fair Competition for the Construction Industry:

1. *Definitions*—The term "Construction Industry" as used herein is defined to mean the designing, the constructing, and the assembling, installing and applying of manufactured parts and products of (a) building structures, including modifications thereof and fixed accessories thereto, intended for use as shelter; and (b) fixed structures and other fixed improvements and modifications, flood control and water power development, reclamation and other similar services required for the public welfare; and the term "Construction Industry" is further defined to include all persons who perform such functions, including without limitations those persons commonly known and sometimes defined by law, as architects, engineers, contractors, and sub-contractors. The term "person" as used herein is taken to mean a natural person, partnership, company, trust, trustee in bankruptcy, association, corporation or agency. The term "employers" shall mean all persons who employ labor in the conduct of any branch of the Construction Industry as defined above. The term "employes" shall mean all persons employed in the conduct of any branch of the Construction Industry as defined above.

2. *Provisions Incorporated from National Industrial Recovery Act*—(a) Employes shall have the right to organize and bargain collectively through representatives of their own choosing, and shall be free from the interference, restraint, or coercion of employers of labor, or their agents, in the designation of such representatives or in self-organization or in other concerted activities for the purpose of collective bargaining or other mutual aid or protection.

(b) No employe and no one seeking employment shall be required as a condition of employment to join any company union or to refrain from joining, organizing, or assisting a labor organization of his own choosing.

(c) Employers shall comply with the maximum hours of labor, minimum rates of pay and other conditions of employment, approved or prescribed by the President.

(d) This Code and all provisions thereof are expressly made subject to the right of the President in accordance with the provisions of Section 10 (b) of the National Industrial Recovery Act from time to time to cancel or modify any order, approval, license, rule or regulation issued with respect hereto under Title I of said Act.

3. *Minimum Wages*—Employers in the Construction Industry shall pay wages:

(a) Not less than the minimum rate of wages for unskilled labor hereby established which shall be not less than forty cents (40c) per hour unless the hourly rate for the same class of work on July 15, 1929, was less than forty cents (40c) per hour in which case the hourly rate shall be not less than that of July 15, 1929, and in no event less than thirty cents (30c) per hour, and furthermore, in any event

(b) Not less than the minimum rate of wages for accounting, clerical or office employes hereby established as follows: $15 per week in any city of 500,000 population, or in the immediate trade area of such city; $14.50 per week in any city of between 250,000 and 500,000 population, or in the immediate trade area of such city; $14 per week in any city of between 2,500 and 250,000 population, or in the immediate trade area of such city; and $12 per week in towns of less than 2,500 population. Population shall be determined by the 1930 Federal census.

(c) Nothing herein contained shall be construed to apply to employes whose rates of wages are established for specific projects by competent governmental authority in accordance with law or with rates of wages established by contracts now in force.

4. *Maximum Hours*—Employers in the Construction Industry shall not employ any employe

(a) In excess of the maximum average of thirty-five (35) hours a week during a six months calendar period, or forty-eight (48) hours in any week in such period, or eight (8) hours in any one day, excluding employes engaged in professional, executive, administrative or supervisory work; those engaged in cases of emergency work requiring the protection of life or property, and those in establishments employing not more than two persons in towns of less than 2,500 population, which towns are not part of a larger trade area. Population shall be determined by the 1930 Federal census.

(b) Employers shall not employ accounting, clerical or office employes in any office or in any place or manner for more than forty (40) hours in any week, excluding employes in managerial or executive capacities and those in establishments employing not more than two persons in towns of less than 2,500 population, which towns are not part of a larger trade area. Population shall be determined by the 1930 Federal census.

(c) Nothing herein contained shall be construed to apply to employes whose hours of labor are established for specific projects by competent governmental authority acting in accordance with law or with hours of work established by contracts now in force.

4-A. *Area Agreement for Hours and Wages*—Minimum rates of wages and maximum hours of labor may be established nationally or for a region or locality by mutual agreements reached through bona fide collective bargaining between truly representative national, regional or local groups of employers and employes, In no event shall such minimum rates of wages be less than those established in Section 3 hereof, nor in any event shall such maximum hours of labor be more than those established in Section 4 hereof, excepting such minimum rates of wages and such maximum hours of labor as are established for specific projects by competent governmental authority acting in accordance with law.

5. *Minimum Wage*—An employer in the Construction Industry shall not employ any minor under the age of sixteen (16) years or under any greater age specified by law or competent governmental authority.

6. *Amendments*—Amendments to or revisions of this code may be proposed by the National Administrative Committee or any national trade association or professional body representative of any recognized functional division within the Construction Industry and when approved in accordance with the provisions of the National Industrial Recovery Act shall become binding upon the Construction Industry.

7. *Administrative Committee*—To effectuate the purposes of this code and of the National Industrial Recovery Act and to provide for administration and co-ordination within the Construction Industry, there is established a "National Administrative Committee" which shall consist of the Policy Committee of the Construction League of the United States, as that committee is from time to time constituted, and three non-voting members to be appointed by the Administrator of the National Industrial Recovery Act. This committee shall have authority to establish such sub-committees and state, regional or local committees, subcommittees or agencies with such delegated powers, as it may deem necessary, and this committee may at any time and from time to time require of any employer, trade association or professional body in the Construction Industry any information relaing to wages of employes, hours of labor or other conditions of or in the Construction Industry pertaining to the provisions or the operation of this code, and may, and at the request of the Administrator shall, from time to time present to him such information or reports as he may require; and this committee may, and at the request of the Administrator shall, present to him such recommendations, as to conditions in the Construction Industry as they may develop, as he may specify, together with such other recommendations as in the opinion of the committee may tend to effectuate the operation of the provisions of this code

or any supplemental code proposed or made a part of the code or the policy of the National Industrial Recovery Act.

8. *Supplemental Codes*—It is intended that this code for the Construction Industry shall be amplified and expanded by supplemental codes prepared and proposed by trade or industrial associations or professional bodies within the Construction Industry representative of the various functions of the Construction Industry or sub-divisions thereof. Such supplemental codes shall, so far as possible, and subject to the general approval of the Administrator, be administered by administrative committees or agencies therein respectively established. Such administrative committees so established shall have the power to hear and to recommend adjustments or reconciliations of any controversy between or complaint made by any employers or associations thereof, who shall be subject to the provisions of any such supplemental code or codes. In the event that any such adjustments or reconciliations so recommended shall not be accepted by such employers, or associations thereof, such administrative committees shall, at the request of any party directly concerned, refer any such controversies or complaints to the National Administrative Committee hereinabove established, for appropriate adjustments by it. In the event that the adjustment or reconciliation recommended by the National Administrative Committee shall not be accepted by any party to the controversy or complaint, the National Administrative Committee shall, at the request of any party directly concerned, refer the matter to the Adminstrator who, at his option, may hear and determine any such controversy or complaint. Any adjustment or reconciliation of any such controversy or complaint determined by the Administrator shall be final and shall bind the employers, or associations thereof, involved in any such controversy or initiating any such complaint.

It is the spirit of the foregoing provisions that, so far as possible, controversies or complaints arising within any of the functional groups or subdivisions of the Construction Industry covered by a supplemental code shall be fully determined and adjusted by the administrative committees or agencies established in such supplemental code, and that, whenever the adjustments or reconciliations recommended by such administrative committee or agencies are consistent with reasonable compromise, recourse shall not be had or appeal made to the National Administrative Committee or to the Administrator.

Any such supplemental codes submitted by such functional groups or sub-divisions of the Construction Industry shall provide for minimum rates of pay not less than and for maximum hours of work not more than the limitations established therefor in this Code.

Supplemental codes prepared by national trade associations or professional bodies within the Construction Industry may be submitted to the National Industrial Recovery Administrator by the National Administrative Committee herein established when consistent with this code and other rules and regulations promulgated by the President and when within the spirit and purpose of the National Industrial Recovery Act, but nothing herein contained shall be construed to prevent a trade association or other representative group or body within the Construction Industry from submitting a code directly to the National Industrial Recovery Administration.

9. *Adjustments*—In the event that any buyer subject to this code shall have contracted before June 16, 1933, to purchase goods, structures, or parts thereof at a fixed price for delivery during the period of the President's Re-employment Agreement, he shall make an appropriate adjustment of said price to meet any increase in cost to the seller caused by the seller's having signed the President's Re-employment Agreement or having become bound by any code of fair competition approved by the President; provided, however, that in view of the fact that construction operations customarily involve the furnishing of various goods and structures, or parts thereof by a continuous series of independent long-term contracts and agreements at fixed prices between various parties, such as owners (including governmental departments), builders, contractors, sub-contractors and others, such adjustments shall be contingent upon similar appropriate adjustments to be made by all other parties thus participating, from and including the initial vendor of such goods and structures or parts thereof to and including the owner of the works or structure upon which they are used.

10. *Bid Peddling Prohibited*—No one in the Construction Industry shall be a party to the unfair practice commonly known throughout the industry as "Bid Peddling." All supplemental codes before receiving the approval of the National Administrative Committee shall contain provisions to enforce this rule.

11. *Administrative Expense*—All employers and persons as defined in this code shall bear their equitable share of the expense incident to the administration of this Code of Fair Competition under such rules and regulations as may be approved by the President under Section 10 (a) of Title I of the National Industrial Recovery Act.

12. *Effective Date*—This code shall become effective on approval by the President of the United States and shall be applicable to all construction work undertaken pursuant to contracts entered into or otherwise commenced after such approval date.

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National Bituminous Pavers' Industrial Association Formed

As a result of a two day meeting held at Washington, D. C., on August 9th and 10th by the country's leading asphalt pavement producers, the National Bituminous Pavers' Industrial Association has been formed as a national group to stand behind President Roosevelt's efforts to stimulate industrial recovery.

The new association adopted a slogan, S-I-R, signifying Skill—Integrity—Responsibility. A code of Fair Practice was adopted which in keeping with the intent of the Recovery Act affords full benefit to labor, and which supervises the quality of the Industry's production to the end that the public shall be assured of appropriate construction and full value for its expenditures.

To obtain self-governing of the industry along these lines within national scope, thirteen regional administrators or directors were appointed from the ranking industrial leaders of the paving business. Listed here are the regions and the appointees:

Region 1—New England States: Mr. E. Sutcliffe, Vice President, Warren Brothers Company, Boston.

Region 2—New York-Pennsylvania District: Mr. Wm. P. McDonald, President, Wm. P. McDonald Co., New York and Lakeland, Florida.

Region 3—Central Western States: Mr. George R. Cooke, President, George R. Cooke Asphalt Paving Company, Detroit.

Region 4—Middle Western States: Mr. Gilbert W. Haggart, President, Haggart Construction Company, Fargo, N. D.

Region 5—Northwest States: Mr. Troy Carmichael, Northwest Road Co., Portland.

Region 6—California District: Mr. Arthur F. Brough, President, Southern California Roads Co., Los Angeles.

Region 7—Southwestern States: Mr. Louis S. Lang, Craven & Lang, Inc., New Orleans, La.

Region 8—Corn Belt States: Mr. Daniel J. Boone, Vice President, Webb-Boone Company, St. Louis, Mo.

Region 9—South Atlantic States: Mr. George B. Carey, President, Carey-Reed Company, Birmingham, Alabama.

Region 10—Southern States: Mr. Larry B. West, President, West Construction Company, Chattanooga, Tenn.

Region 11—District of Columbia and insular possessions: Mr. A. G. Rolfe, McGuire & Rolfe, Washington, D. C.

Of these directors the following were chosen officers for the ensuing year: President, Mr. E. Sutcliffe, Vice Presidents, Mr. William P. McDonald and Mr. Larry B. West, Secretary-Treasurer, Mr. Troy Carmichael.

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ASPHALT INSTITUTE OFFERS REPRINT OF PAPERS.—The Asphalt Institute has prepared reprints of the papers presented at the 10th Annual Asphalt Paving Conference. The papers include the following: Highway Economics (3 pamphlets), Low Cost Highways (6 pamphlets), Emulsified Asphalts (1 book), Pavement Types (3 pamphlets), Highway Equipment (1 book), Technical Session (5 pamphlets). The reprints can be obtained on application to J. E. Pennybacker, Managing Director of the Institute, 801 Second Ave., New York City.

Code of Fair Competition for General Contractors

A PROPOSED code of fair competition for the general contractors' division of the construction industry was submitted to National Recovery Administration on Aug. 25. This code when adopted is to be supplemental to the basic code for construction. The proposed basic code appears on another page of this issue. The general contractors' code as submitted follows:

To effectuate the purpose and policy of Title I of the National Industrial Recovery Act, the following provsions shall constitute the Code of Fair Competition for the General Contractors' Division of the Construction Industry.

ARTICLE I—The Code of Fair Competition for the Construction Industry, as approved by the President of the United States, is adopted and made part hereof and shall be attached hereto, and any provision of this Code of Fair competition for General Contractors which may be inconsistent therewith shall yield thereto.

ARTICLE II—**Definition and Functions of a "General Contractor"**

Section 1. The term "general contractor" is hereby defined to mean any individual, partnership, association, trust trustee, trustee in bankruptcy, receiver corporation or agency which undertakes, whether by formal contract or otherwise, to direct, supervise, coordinate or execute, substantially in its entirety, the work of constructing any fixed structural or physical improvement, or a modification thereof, or an addition or repair thereto, excluding any such operation aggregating in its entirety less than the sum of $1,000.

It is recognized that the function of the architect and engineer is to design or plan construction projects and acting in their professional capacity to supervise and coordinate the execution thereof on behalf of the owner. Such normal or customary functions of architects and engineers shall not be deemed to be included in the foregoing definition of a general contractor. Such normal or customary functions of architects and engineers excluded, any person undertaking to direct, supervise, coordinate or execute any such construction project, or any such portions thereof, shall be deemed a general contractor for the purposes of the code in so far as the same shall apply.

Section 2. The term "employer" shall mean any general contractor as defined herein.

Section 3. The term "employee" shall mean any person employed by a general contractor.

Section 4. The term "national trade association" as used herein shall mean the Associated General Contractors of America.

ARTICLE III—**Labor Provisions**

Section 1. (a) Employees shall have the right to organize and bargain collectively through representatives of their own choosing, and shall be free from interference, restraint or coercion of employers of labor or their agents in the designation of such representatives or in self organization or in other concerted activities for the purpose of collective bargaining or other mutual aid or protection.

(b) No employee and no one seeking employment shall be required as a condition of employment to join any company union or to refrain from joining, organizing or assisting a labor organization of his own choosing.

(c) Employers shall comply with the maximum hours of labor, minimum rates of pay and other conditions of employment, approved or prescribed by the President of the United States.

Section 2. **Minimum Wages**—On and after the effective date:

(a) The minimum rate of wages for unskilled labor shall not be less than forty cents (40c) per hour unless the hourly rate for the same class of work on July 15, 1929, was less than forty cents (40c) per hour in which case the hourly rate shall be not less than that of July 15, 1929, and in no event less than thirty cents (30c) per hour.

(b) The minimum rate of wages for accounting, clerical or office employees shall be not less than $15 per week in any city of over 500,000 population, or in the immediate trade area of such city; $14.50 per week in any city of between 250,000 and 500,000 population, or in the immediate trade area of such city; $14.00 per week in any city of between 2,500 and 250,000 population, or in the immediate trade area of such city; and $12 per week in towns of less than 2,500 population. Population shall be determined by the 1930 federal census.

(c) Nothing herein contained shall be construed to apply to employees whose rates of wages are established for specific projects by competent governmental authority in accordance with law or to employees whose rates of wages are established by contracts now in force.

(d) A general contractor shall not knowingly employ any sub-contractors or other agencies (requiring the services of laborers or mechanics on the site of the work) who pay less than the established minimum rates of wage.

(e) A general contractor shall pay not less than the established minimum rate of pay regardless of whether the employee is compensated on the basis of a time rate or on piece work performance.

Section 3. **Maximum Hours**—On and after the effective date:

(a) The maximum hours of labor shall not be more than a maximum average of thirty-five (35) hours a week during a six months' calendar period, or forty-eight (48) hours in any week in such period, or eight (8) hours in any one day, excluding employees engaged in professional, executive, administrative or supervisory work receiving in excess of $25 per week, excluding accounting, clerical and office employees; excluding employees engaged in cases of emergency work requiring the protection of life or property, and watchmen and repairmen while repairing breakdowns in equipment, and excluding employees in establishments employing not more than two persons in towns of less than 2,500 population, which towns are not part of a larger trade area. Population shall be determined by the 1930 federal census.

(b) Employers shall not employ accounting, clerical or office employees in any office or in any place or manner for more than forty (40) hours in any week.

(c) Nothing herein contained shall be construed to apply to employees whose hours of labor are established for specific projects by competent governmental authority acting in accordance with laws or to employees whose hours of work are established by contracts now in force.

(d) A general contractor shall not knowingly employ subcontractors or other agencies (requiring the services of laborers or mechanics on the site of the work) who do not observe strictly these provisions, including without limitation the provisions as to hours of labor and rates of pay.

Section 4. **Area Agreement for Hours and Wages**—Standards of minimum rates of wages and maximum hours of labor may be established nationally or for a specific region or locality by mutual agreements reached through bona fide collective bargaining between truly representative national, regional or local groups of employers and employees. In no event shall such minimum rates of wages be less than those established in Section 2 hereof, nor in any event shall such maximum hours of labor be more than those established in Section 3 hereof, excepting such minimum rates of wages and such maximum hours of labor as are established for specific projects by competent governmental authority acting in accordance with law.

Section 5. **Labor Welfare**—A general contractor shall adequately provide for the welfare and safety of his workmen. He shall comply, except as superseded by the state laws, with the provisions of the Safety Manual adopted by the Associated General Contractors of America, or the Safety Platform of the Construction League of the United States, or the rules set forth by the National Safety Council and local ordinances referring to safety measures in so far as the same may apply to his class of work.

Section 6. **Minimum Age**—A general contractor shall not employ any minor under the age of sixteen (16) years or under greater age specified for a given state or locality, by law or competent governmental authority.

Section 7. **No Prison Labor**—A general contractor shall not employ prison labor in the execution of the work.

Section 8. **Payment of Wages**—A general contractor shall make payment of all wages as due in lawful currency of the United States, or by a negotiable check therefor payable on demand. The contractor or his agents shall accept no rebates

directly or indirectly on such wages, nor give anything of value or extend favors to any person for the purpose of influencing rates of wages or the working conditions of his employees.

ARTICLE IV—**Regulations Governing Relations with Sub-Contractors, Material Vendors and Others**

Section 1. **Payments**—Funds received by a general contractor for construction work performed or to be performed by him shall be accepted and applied first for the purpose of paying amounts due from him to others in respect of any portion of such work including amounts due to employees, material men, sub-contractors and others. These provisions shall not be construed to require a general contractor to keep in separate bank accounts or deposits the funds received under separate contracts, provided that he shall maintain books of accounts which shall clearly show the allocation to each and every contract of the funds deposited in his general or special bank account or accounts, and he shall make final payment of the balances due from him to such others within ten days after he has received final payments from the owner, except that earlier payments and/or greater amounts may be mutually agreed upon.

Section 2. **Prohibited Rebates, Etc.**—A general contractor shall not give or accept rebates, refunds, allowances, unearned discounts or special services to or from sub-contractors, material vendors or others which are not extended under like terms and conditions to or by other sub-contractors, material vendors and others of equal credit rating.

Section 3. **Financing**—A general contractor shall not permit sub-contractors or material vendors on a specific contract to finance or guarantee his accounts.

Section 4. **Bids Confidential**—A general contractor shall not convey to any sub-contractor or material vendor any substantial information prior to the award of the particular sub-contract relating to the bid of any other sub-contractor or material vendor who has made a bid to him or to any other general contractor, nor shall he mislead or deceive any sub-contractor or material vendor as to the amounts and conditions of other bids for the purpose of obtaining a lower bid.

Section 5. **General Requirements**—A general contractor, in his relations with sub-contractors, material vendors and others, shall, so far as he may legally do so, require such parties to adhere to the provisions of this Code of Fair Competition.

Section 6. **Waiver of Legal Rights**—A general contractor, in his contractual relations with other parties, shall not waive any rights affecting another party of interest without first fully informing such other party as to such action and receiving his prior consent in writing.

Section 7. **Plans and Specifications**—A general contractor shall not be held responsible or penalized for deficiences in or omissions from the plans and/or specifications prepared by others and upon which the contract is based.

ARTICLE V—**Regulations Governing General Contractors.**

Section 1. **Qualifications**—A general contractor bidding upon or undertaking to execute construction contracts shall be properly qualified by capital, organization and experience. He shall own or have available sufficient and proper equipment to execute the work bid upon.

Section 2. **Performance Records**—A general contractor submitting a bid for public works construction shall, as an essential precedent condition of qualification for public works construction, file his performance record with the Bureau of Contract Information, Washington, D. C., or any other agency authorized and designated by the Public Works Administrator acting under the authority of Title II of the Act. Such records shall be available only to those entitled to information by reason of their responsibility for the award of contracts, the writing of contract bonds or the extension of credit. A general contractor shall keep such records current by submitting supplemental data at such periods as the agency shall prescribe.

Section 3. **Credit Information**—A general contractor shall make available upon request to those responsible for the award of construction contracts, pertinent information as to his current financial position, using the standard questionnaire forms developed and approved by and available through the Joint Conference on Construction Practices, Washington, D. C., or other forms approved or prescribed by the Administrator, and may request equivalent information from the owner.

Section 4. **Records and Accounts**—A general contractor shall maintain and employ an adequate system of records and accounts, which system shall clearly show the allocation as to each specific project of all funds received or disbursed on account thereof, and he shall furnish to the National Industrial Control Committee for General Contractors hereinafter established such information, reports and data as may from time to time be required by it.

Section 5. **Contractual Agreements**—The following bases of contractual agreements are recognized as fair trade practices: guaranteed price, cost of the work plus a fee, unit price, lump sum, and other contractual methods not inimical to the public interest, providing that the regulations contained in this Code of Fair Competition are met.

Section 6. **Submitting Bids**—In order that whenever contracts are to be let by competitive bidding the terms of the competition shall be such as to insure fair competition, a general contractor, in submitting bids for the construction or improvement of either public or private works, shall be governed by the following regulations:

(a) All bids shall be in writing, signed by an authorized representative of the bidder. Alternate proposals may be submitted with the original bid providing the same privilege is extended to all bidders.

(b) A general contractor shall not take advantage in his bid of any special privileges, favors or understanding had with him by persons in control of the award. This, however, shall not prevent any such competitor, even though not the lowest bidder, from taking such contract, providing the award is made at his original competitive bid price, nor shall it prevent any contractor from accepting the award of such contract at any price where no competitive bids are taken.

(c) A general contractor shall not revise his bid after bids have been opened in order to improve his position with the owner, except he be the low bidder. Bona fide errors discovered after the opening of bids may be grounds for withdrawal of bid.

Where supplemental bids are requested because of substantial changes in the plans and/or specifications, such bids shall reflect only the true value of the changes.

He shall not encourage or induce the owner or his agent to reject bids and re-advertise in order that he may revise his original offer, nor shall any general contractor bid upon a construction project upon which bids have been opened, or at any time within 90 days next thereafter, except where there be substantial changes of the plans and specifications.

(d) A general contractor shall not knowingly submit a bid nor accept a contract which does not include all direct and indirect costs and include a reasonable amount of profit, and he shall maintain and keep on file his original estimates supporting his bid or contract.

Standards of accounting, cost keeping and estimating may be prescribed for the purpose of determining a fair price for service or product and systems for the interchange of such information subsequent to the award of specific work may be established.

(e) A general contractor shall not be required to accept the award of a contract after fifteen (15) days after the date of opening of bids.

(f) To establish parity in bidding as to wages, prior to the establishment of wage rates according to Section 7 (b) of the Act there should be established by competent authority rates on which all bidders shall base their bids (as set forth in Article III, Section 2, herein) and which shall be effective under the contract until other rates have been established as provided by Section 7 (b) of the Act, when they shall become effective after which a proper adjustment of the contract price as to wages shall be made between the owner and contractor.

Section 7. **Payments**—A general contractor shall demand and insist upon receiving the contract payments as they become due in lawful money of the United States or its equivalent, as provided by the contract, and he shall not waive his right to receive any part of such contract payments, nor shall he return to the owner or his agent any part of such contract payments, nor shall he return to the owner or his agent any money or render him any service or give him anything of value not required by the contract.

Section 8. **Bid Peddling**—A general contractor shall not engage in the unfair practice known to the industry as "bid peddling" or any similar unfair practice, nor shall he knowingly aid or engage in an unfair trade practice, and shall refuse to deal, in so far as may be applicable, with any person who shall fail to comply with this code.

Section 9. **Surety**—A prequalified general contractor, who has met the necessary qualifications entitling him to the work, but who is unable, due to conditions beyond his control, to obtain the proper surety required by the contract, may agree with the owner and the National Industrial Control Committee for General Contractors upon a suretyship of some other nature.

Section 10. **Disputes**—A general contractor shall be ready and willing to settle disputed matters promptly. Where arbitration as a method of settling disputed matters is agreed upon, the rules of procedure as established by the American

Arbitration Association shall govern, except as otherwise required by law. Payment, exceeding that sufficient to cover the amounts in dispute, shall not be withheld from the parties affected.

Section 11. **Adjustments**—In the event that any buyer subject to this code shall have contracted before June 16, 1933, to purchase goods, structures, or parts thereof, at a fixed price for delivery during the period of the President's Reemployment Agreement, he shall make an appropriate adjustment of said price to meet any increase in cost to the seller caused by the seller's having signed the President's Reemployment Agreement or having become bound by any code of fair competition approved by the President; provided, however, that in view of the fact that construction operations customarily involve the furnishing of various goods and structures, or parts thereof, by a continuous series of independent long-term contracts and agreements at fixed prices between various parties, such as owners (including governmental departments), builders, contractors, sub-contractors and others, such adjustments shall be contingent upon similar appropriate adjustments to be made by all other parties thus participating, from and including the initial vendor of such goods and structures, or parts thereof, to and including the owner of the works or structure upon which they are used.

ARTICLE VI.—**Regulations Correlating All Construction Works Interests**

To effectuate the purpose and the policy of the National Industrial Recovery Act in a construction work contract, all interested parties and participants or their agents shall be obligated to adhere and conform to the basic principles regulating the construction industry, as established in the Code of Fair Competition for the Construction Industry and the various functional codes supplemental thereto including this Code of Fair Competition for General Contractors as the same may be applicable.

ARTICLE VII—**Administration**

Section 1. (a) The President may from time to time cancel or modify any order, approval, license, rule or regulation issued under Title I of the National Industrial Recovery Act in respect to this code.

(b) This code is intended to be a basic code for general contractors, and a study of trade practices and conditions in the industry will be made by the National Industrial Control Committee for General Contractors hereinafter established with a view to their submission to the administrator for approval from time to time such additions and modifications hereto applicable to the industry generally and such supplemental codes applicable to one or more branches or subdivisions of the industry, as the National Industrial Control committee for General Contractors may deem necessary or appropriate to meet conditions in the industry or to effectuate the policy and purpose of the National Industrial Recovery Act, provided that any such supplemental code or codes shall conform to and be consistent with the provisions of this code as now constituted or hereafter changed.

(c) It is expressly recognized that the President of the United States may as a condition of his approval of this code impose such conditions (including requirements for the making of reports and the keeping of accounts) as may be expedient in the furtherance of the public interest for the protection of consumers, competitors, employees and others and may provide such exceptions to and exemptions from the provisions of the code as the President of the United States in his discretion deems necessary to effectuate the policy herein declared.

Section 2. **Administration Committee**—(a) To effectuate the purposes of this code and provide for administrative control within the industry, there is established a "National Industrial Control Committee for General Contractors," twelve members of which shall be appointed by the Executive Committee of the Associated General Contractors of America (from its Board of Governors) duly elected by the members of that national trade association. The twelve members so appointed shall appoint to the committee five additional persons from within the industry who are not representative of or responsible to members of the Associated General Contractors of America. In the selection of the National Industrial Control Committee for General Contractors, proportionate representation shall be accorded the major occupational groups, namely, building construction, highway construction, public works construction, railroad construction and such other occupational groups as may become necessary.

(b) The National Industrial Control Committee for General Contractors shall have full authority to make all needful rules and regulations for the administration and enforcement of the provisions of this code, and, upon the complaint in writing of a local or regional committee or interested parties or upon its own initiative, shall make such inquiry and investigation and take such other action as may be necessary upon the operation of this code. This committee shall have full authority to establish occupational, state, local and regional committees and prescribe such duties, rules and regulations as are deemed necessary to carry out the purpose of this code and the National Industrial Recovery Act. The right of appeal from and review of the decisions of a subordinate committee to next higher committee in authority shall be preserved.

Section 3. The National Industrial Control Committee for General Contractors shall coordinate its acts with the administrative agency established under the Code of Fair Competition for the Construction Industry.

Section 4. **Administrative Expense**—The cost of the supervision needed to secure proper observance of this code and any additions thereto, compilation of statistical data and such other activities as may be necessary shall be apportioned equitably, so far as practicable, to all persons within the industry.

Section 5. **Effective Date**—This code shall be effective when approved by the President of the United States and shall be applicable to all construction work undertaken pursuant to contracts entered into or otherwise commenced after such approval date and to existing contracts where the same may be adjusted as provided in Article V, Section 11 hereof.

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Hourly Wages on Federal-Aid Highway Projects, 1922 to 1932

The average hourly wage rates paid to common labor employed on Federal-aid highway projects in each of the years 1922 to 1931 and in each month of 1932 from January to October, inclusive, are shown in the table below. The figures for the years 1922 to 1931 are from the Yearbook of Agriculture, 1932, published by the United States Department of Agriculture, and for the months of 1932, from the Survey of Current Business for January, 1933, published by the United States Bureau of Foreign and Domestic Commerce.

AVERAGE HOURLY WAGE RATES OF COMMON LABOR EMPLOYED ON FEDERAL AID HIGHWAY PROJECTS, 1922 TO 1931, AND JANUARY TO OCTOBER, 1932

Year and month	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific	United States
	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.
1922.....	40	37	33	32	21	20	24	38	49	33
1923.....	53	47	41	36	27	23	25	41	54	39
1924.....	49	43	40	36	28	24	27	40	53	38
1925.....	46	43	37	37	27	25	26	44	52	38
1926.....	49	47	38	36	29	25	27	44	52	38
1927.....	49	47	39	37	28	25	30	45	53	40
1928.....	49	43	39	38	26	26	28	46	52	41
1929.....	51	43	39	37	28	26	31	47	53	39
1930.....	50	42	38	37	25	24	28	47	53	39
1931.....	45	37	36	35	22	20	23	45	51	36
1932—										
January .	41	37	40	38	18	19	24	45	50	32
February.	43	40	40	42	21	17	25	44	49	33
March ...	44	38	40	37	19	16	27	45	47	34
April	39	40	37	33	20	19	24	44	48	33
May	34	36	36	28	20	19	25	44	47	32
June	34	35	36	31	20	19	25	44	47	33
July	34	34	35	31	18	19	26	44	46	32
August ..	33	34	36	31	18	19	26	43	47	32
September	34	34	36	34	19	19	26	44	47	32
October .	34	35	37	32	19	19	27	44	48	32

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NEW HIGHWAY FOR SALVADOR AND HONDURAS.—According to Foreign Highway News the next budget of El Salvador will provide for surveying a road from San Salvador through Chalatenango to Citala on the Honduran border. The Honduran Congress has provided for the survey of a section of road from San Pedro Sula, through Santa Rosa de Copan, terminating at Ocotepeque, the Salvadoran frontier. Construction of this international road will open up one of the richest agricultural zones of Honduras and give Salvador a clear connection with the Caribbean.

Construction Methods on French King Bridge, Mohawk Trail, Massachusetts

By Albert E. Kleinert, Jr.
Assistant Structural Engineer, Massachusetts Department of Public Works

IN SELECTING the type of bridge, the following conditions were the governing factors: The new road was to be carried across the river at an elevation about 135 ft. above the water level. The banks on each side of the river were high and steep and a narrow road had been built into the east bank at a grade approximately 30 ft. above the water level. There was rock, suitable for foundations, within a few feet of the surface of the ground. The bottom of the river was uneven and rocky, and the depth of the water varied, being 34 ft. at the deepest point. At this location the river was comparatively narrow, being only 425 ft. wide, and as the water was ponded for power purposes, any reduction in the waterway was prohibited. Damage to substructures by floating ice also ruled against piers in the river. With these conditions in mind, the endeavor was made to develop a bridge which not only fitted the site, but which could be erected by cantilever construction, since the deep water, rocky river bed, and the swift current discouraged the use of falsework in the river. The result of our studies is a steel deck structure, continuous over four supports, two of which are abutments placed at the ends of the bridge, high on the banks, and the other two are piers placed at the edges of the river. The superstructure is not only continuous over the four supports, but it is also fixed against horizontal movement at both of the piers. It is fixed for all loads, including the dead load of the steel itself, as definite reactions were jacked into the trusses at the conclusion of the erection. At the abutments, provision was made for the longitudinal expansion and contraction by supporting the ends of the bridge on roller nests. In naming the type of this structure we have used the term "steel continuous spandrel braced arch," because it is a steel spandrel braced arch between the piers, and is continuous to each abutment where it receives vertical support.

Details of Trusses—The trusses, spaced 41 ft. apart, are identical and are 782 ft. long between end pins and 460 ft. long between river piers. They are divided into 34 panels, each 23 ft. long, there being 20 panels in the center span and 7 in each of the end spans. The top chord is parallel to the profile of the center line of the road, which is a vertical curve with a 20,000-ft. radius. This curvature has 4 ft. for a middle ordinate to a chord drawn between the ends of the abutments. The bottom chords are parabolic in shape and have a rise of one-fifth of the center span, or 92 ft. for each span. Allchord members are straight between panel points. The web system is a Pratt type. The bottom chord member L_7-L_8, for the first panel out over the river from the pier, has a cross-sectional area of 211 sq. in., and is the heaviest member per foot of length in the bridge. The vertical at the pier has an area of 156 sq. in. Its length is 108 ft. The top chord at the center has an area of 85 sq. in., and the bottom chord has an area of 91 sq. in. The remaining members vary from 100 sq. in. down to 25, the latter being the verticals over the abutments. All truss members were built up of plates and angles, with lacing bars and battens for ties.

Provision was made for secondary stresses where it was found necessary, not only for the members, but for the joints as well. In fabricating the members of the trusses, their lengths were changed by the magnitude of the deformation which resulted from the stresses produced by the dead load plus one-half of the live load, so that the trusses, with these loads applied, will have the same shape and dimensions which were used in their design.

For the wind or lateral bracing, "K" type truss systerms were built in the planes of the top and bottom chords, and light cross frames were placed at each panel point. At the abutments, and over the piers, the cross

French King Bridge Spanning Connecticut River on the Mohawk Trail Highway in Massachusetts

frames were designed sufficiently heavy to carry the reactions from the top chord lateral trusses to the foundations.

Floor System.—The floor system of the bridge was made up of plate girder floor beams framed into the verticals of the trusses, rolled I-beam stringers supported on top of these girders, and a 6½-in. reinforced concrete slab deck carrying a roadway 40 ft. wide, and a 6-ft. sidewalk. The roadway has a 2-in. bituminous concrete

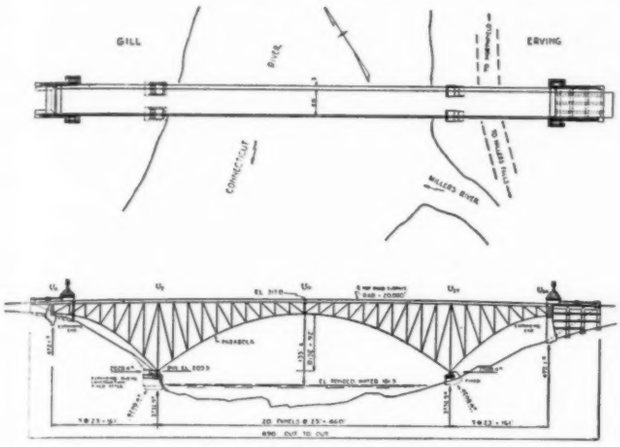


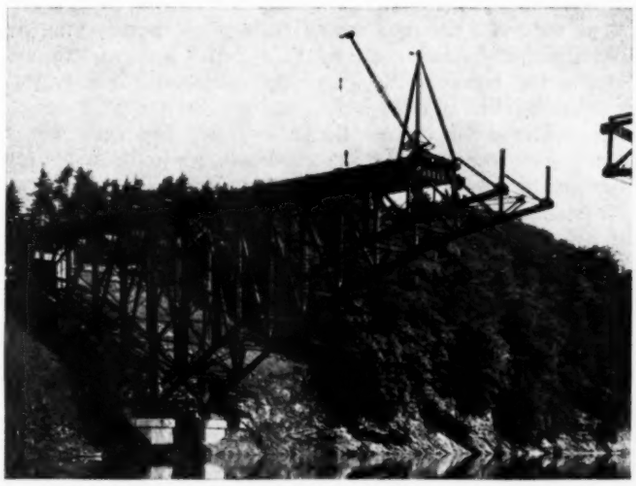
Fig. 1. *Plan and Profile*

wearing surface. The floor system was so placed relative to the trusses that both trusses are stressed almost the same, making it possible to have the four halves of the two trusses identical, although there is a sidewalk on one side of the bridge which makes the loading unsymmetrical about the center line of construction. Because of the height of the roadway above the river it was thought advisable to have a double curb. This consists of the regular 9-in. reinforced concrete curb, with an additional 11-in. curb placed on top of it but set back 6 in. from the face. In effect, it is equivalent to a 20-in. curb, but

Construction View of Erving Side Taken June 15, 1932

eliminates the possibility of damage to the fenders, wheels and other parts of cars. Further protection is furnished by a wrought-iron fence bolted to cast steel supports which were embedded in the concrete. The fence was built up of wrought-iron pipe rails, pales and bars, welded together both for strength and protection against corosion. Great care was taken to eliminate, as far as possible, all crevices or pockets difficult to paint and where moisture might collect.

Bearings.—At the ends of the bridge on the abutments, the trusses are supported by forged steel pins 9 in. in diameter which are carried by cast steel shoes bearing on nests of 7-in. steel rollers. These nests are enclosed in steel boxes filled with a heavy gear grease to insure their protection from dirt and water. To facilitate inspection the sides of the grease boxes are made so that they can be taken off and the grease removed. Adjacent to these shoes and rollers are the vertical ties which provide for a possible but highly improbable reversal of reaction, and were used primarily to tie down the ends of the bridge during the cantilever erection. These ties, made up of 22-in. by 1-in. plate with clevices and turnbuckles pinned to them, were connected at their upper ends to the end floor beams, and at their lower ends to plates riveted to steel frames buried in the concrete abutments. A flexible horizontal tie to take the reactions from the lateral "K" trusses was also connected to these abutment plates, and thus relieved the rollers of all but the vertical loads. The



View Taken July 5, 1932, *Showing Erection Progress on Erving Side*

maximum positive reaction on the rollers is 513,000 lb., and to reverse this and bring the ties into action it would be necessary to have all of the live loads simultaneously applied so as to produce only a negative reaction. While this is possible and has been provided for, it is believed that it is quite improbable.

At the piers the trusses were also supported by forged steel pins and cast steel shoes, the latter weighing 15 tons. The pins were 14 in. in diameter, and weighed slightly under 1 ton apiece. Since the piers furnished a horizontal as well as a vertical component for the reaction. the shoes were designed with a horizontal as well as a vertical bearing surface. On the Erving or east piers, both surfaces bear on steel beam grillages embedded in the concrete of the piers. Four pairs of anchor bolts hold each shoe rigidly in place. For the Gill or west piers the shoes were carried during erection on a set of rollers which were supported on a steel beam grillage. The horizontal reaction is transmitted to the pier through a pair of 12-in. "H" columns, 3 ft. 6 in. on centers, placed horizontally between the back of the shoe and the grillage in the vertical face of the pier. Provision was made for placing a 500-ton jack between these columns. This was used for jacking reactions into the trusses after the erection of the steel was completed.

Piers and Abutments.—The piers and abutments are of concrete. The elevation of the shoes at the piers is 2 ft.

Construction View on Gill Side

above the highest flood stage of the river. The piers consist of separate footings under each shoe, each having a width parallel to the river of 17 ft., and a depth transverse to the river of 26 ft. on the east bank and 34 ft. on the west bank, where they extend back to the solid ledge. The depth varies because all of the piers were carried down about 4 ft. into bedrock, to withstand any tendency to displacement by flood or ice. The footings on the east bank are above ordinary water level, but on the west side the excavation extended about 6 ft. below the water in order to remove loose and soft rock on the surface. The abutment on the east side is 84 ft. long and 51 ft. wide, and has a height of 60 ft. at the bridge seat. It is of cellular construction and has a top slab which serves as a road. The foundations rest upon ledge a few feet below the surface. The rear of the abutment is open and the aproach fill extends between as well as around the wings. The westerly abutment is 70 ft. long and 20 ft. high, and is of the gravity type of construction consisting of gravity walls built up to support the end of the bridge, with pylons extending above the roadway, as on the easterly side. For appearance the Gill pylons were placed 26 ft. nearer the river than those on the opposite bank. A simple architectural treatment was used to relieve the monotony of the plain concrete surfaces.

Specifications.—All design was made according to the specifications of the American Association of State Highway Officials, dated 1931. The loads provided for were: dead load, uniform and concentrated highway loads for the H-20 loading, impact, sidewalk load, wind or lateral loads, and temperature. The latter was for a variation of 60°above and below 50° Fahrenheit.

Construction of Substructure.—There were two contracts for the construction of the bridge, one for the substructures and the other for the superstructure. The substructure contract was awarded to Simpson Brothers Corporation of Boston. No unusual difficulty was experienced in executing this contract. Most of the excavation was to grades above the level of the water in the river. Other than the rock excavation for the Gill piers, which were built upon a shelf cut into the bank, all the excavation that was necessary was the removal of a few feet of earth covering and a roughening of the surface of the rock. The pouring of the concrete and the placing of the reinforcing steel followed the usual course for such construction. The contractor carried out his various operations on both sides of the river at the same time, with exceptional speed and efficiency, and was able to complete this contract in the five months, beginning in September, 1931, and ending in January, 1932. The weather conditions were extremely favorable during this period, so that only a few days were lost.

Erection of Steel.—In November, 1931, the second contract was awarded to the McClintic-Marshall Corpora-

View Taken on July 5, 1932, Showing Down Stream Section Connected.

tion, and during the following April work commenced on the erection of the steel at the Erving end of the bridge. The shore spans were built upon falsework placed at panel points, 2, 4 and 6. This falsework was made up of some of the steel members from the Gill end of the bridge. That for panel point 2 consisted of the floor beam, the two truss verticals, and the sway frame diagonals, all from panel 12. The same pieces

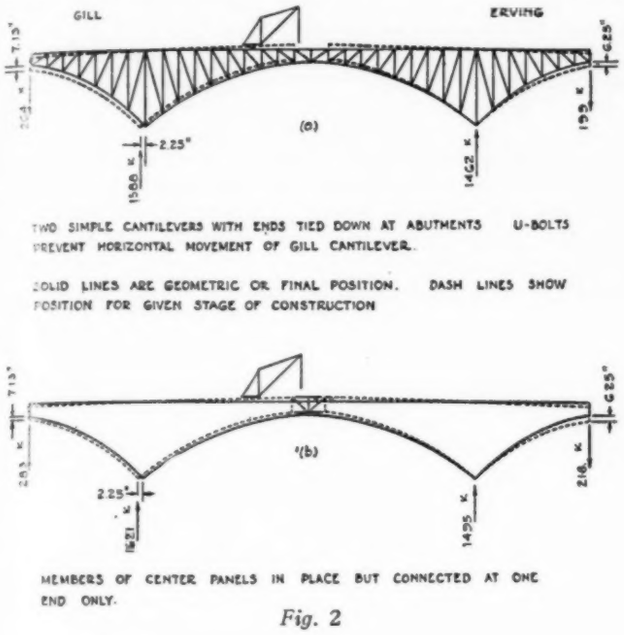


Fig. 2

from panels 4 and 17 were used at panel points 4 and 6, respectively. These pieces were erected upside down on adjustable steel wedge jacks supported by low timber cribbing, and then the truss steel was built up on special connections on the upper ends of the falsework verticals. After the steel at the piers had been placed, the erection proceeded by cantilevering out over the river, with the ends of the trusses tied down at the abutments. To prevent any horizontal movement from taking place during erection, the ends of the trusses were also anchored to large "U" bolts embedded in the parapet or vertical walls, directly opposite the end pins.

The traveler was made up of a stiff leg derrick with 35-ton capacity. It had a 75-ft. boom with a 5-ft. 8-in. gaff attached for a separate line to assist during erection. The weight of the traveler complete was 60 tons. The legs of the derrick were so placed that the steel for erection delivered in back of the traveler was picked up by the boom and then swung around and placed in the bridge in front. The traveler was carried on a framework mounted on wheels which ran along a track laid on a plank platform or roadway which was built on the bridge stringers. This roadway was made of 6-in. by 12-in. plank 18 ft. long, and was used by trucks hauling the steel from the freight yard to the site. The trucks drove right out on the bridge up to the traveler. Here the traveler unloaded and placed the steel immediately in the bridge, thereby eliminating all storage and rehandling at the site of the work. Wherever possible, the steel was fabricated in two panel lengths, and erection was planned accordingly; that is, two panels erected, plank roadway laid, traveler advanced two panels, and the next two panels repeated the same cycle. Riveting followed as closely as possible.

When panel 16 had been erected in the Erving half of the bridge, the traveler was rolled back to the abutment again, stopping on the way to remove the falsework at panels 6, 4 and 2. At the abutment it was dismantled and carried around to the Gill side where it was reassembled to continue the erection of the bridge.

With but few exceptions, the procedure for the Gill half followed closely that for the Erving. Short timber falsework was used for the shore spans, since the ground was much higher than on the Erving bank. A second difference was the placing of the Gill pier shoes upon roller nests to provide for the horizontal displacements during the jacking operations which were to follow the erection.

When panel 16 was reached and placed, the structure was a pair of simple cantilevers ready to be connected, each cantilever supported at the pier and tied down at the abutment. In Fig. 2, (a) shows the conditions at this stage of the erection, and gives the reactions in Kips, and the deformations or deflections in inches. The solid lines represent the geometric or final shape of the trusses, while the dash lines show the shape as of the stage mentioned. The differences between the reactions and deflections of both the cantilevers are due to the extra load of the erection equipment on the Gill side. At this stage, everything was ready for the placing of the steel for the two center panels. Fig. 2 (b) shows this steel in position, with the chord members supported by the gusset plates on the lateral truss systems and the web members bolted at one end only, the diagonals on the upper end and the vertical on the lower. Complete connection was impossible, since the cantilevers were both erected out of position; that is, the Erving end was built high at the river end and 6¼ in. low at the abutment; the Gill side

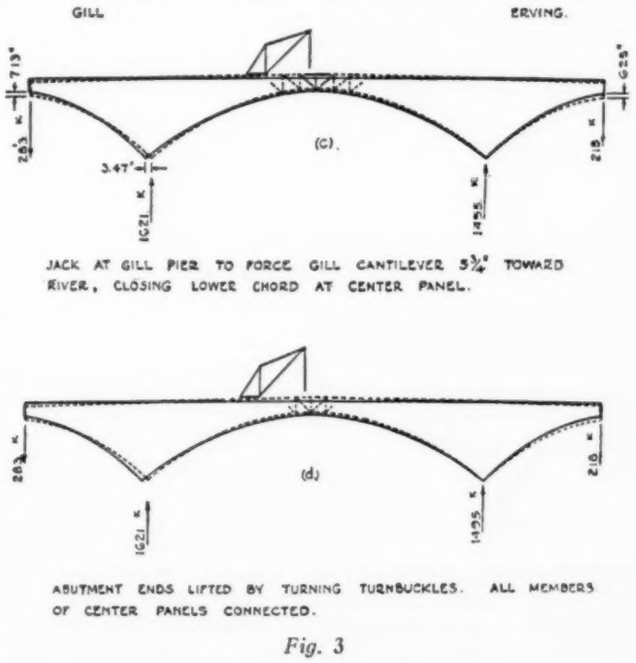


Fig. 3

was likewise high at the river end and 7⅛ in. low at the abutment. This was done to provide for the deflections which accompanied the final jacking, and also to insure the connection at the center by lifting the abutment ends rather than drawing them down. The Gill side was also erected 2¼ in. back from the normal or final position. Therefore the entire Gill half of the bridge, weighing 1,300 tons, was moved forward 5¾ in. until the bottom chords closed at the center. This movement was made by operating the 500-ton jacks at the piers. Conditions at this stage are those in Fig. 3 (c), the bottom chords closed, but the other center panel members still to be connected. To complete the closure of these members

it was necessary to lift the ends of the trusses at the abutments by working the turnbuckles so as to lower the center and bring into position the open holes for the rivets. In Fig. 3 (d) shows all of the steel connected at the center panels.

The next step was to place the remainder of the steel in the floor and bracing system. With this completed, the traveler and the plank floor were removed and the Gill turnbuckles were again turned to offset the reduction

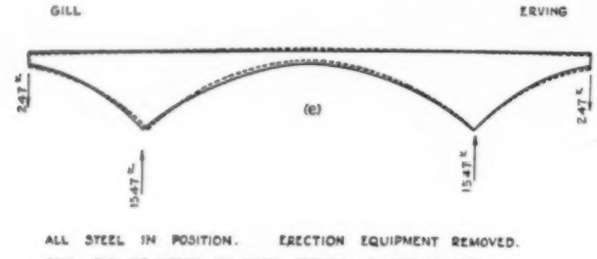


Fig. 4

in load upon the structure. Both halves were then alike in reactions, ties and deflections, as is shown by (e) in Fig. 4. All riveting in the trusses was then completed.

During all of these operations the abutment ends of the trusses were below the final position. To allow for this displacement, the roller nests had to be omitted during the erection. However, as they had to be placed before the final jacking occurred, this was the next operation. In order to get them under, the ends of the trusses had to be lifted until they were sufficiently above their normal elevations to give the necessary clearance for sliding the nests and grease boxes into position. This lifting was accomplished by operating the pier jacks until they registered a force of 440 Kips at each of the shoes, which entirely neutralized the stress in the end ties so that the clevice pins could be removed from the eyebolts. Fig. 4 (f) shows this stage. With the ties inoperative, the pressure in the jacks was reduced until it was only 280 Kips. With this reduction there was an upward deflection of the ends of the bridge to a grade about one-half inch above the normal which was sufficient to permit the rollers in their boxes to be inserted. In Fig. 5, (g) shows the conditions.

The bridge was then ready for the final stressing by jacking the computed reactions into the shoes on both abutments and at the Gill piers. These reactions were those necessary to make the bridge a continuous spandrel braced arch for the dead load of the steel. There were 100-ton jacks placed under each end of the trusses at the abutments, and these were operated simultaneously with the pier jacks to produce the desired reactions. There were 113 Kips for each of the end jacks, and 580 Kips for each of the pier jacks, all of which is shown in (h) in Fig. 5. All of the reactions computed included a correction for temperature which at the time of these operations was 85 degrees.

To transfer these reactions from the jacks to the shoes, it was necessary to follow immediately with the placing of wedge plates and shims. At the abutments, tapered wedge plates were driven under the plates carrying the roller nests, until the jacks were relieved of a part of their load, and then pressure was released and the jacks removed. At the piers, shim plates were placed and molten linotype metal was poured to take up all of the play between the ends of the horizontal struts and the grillages buried in the concrete. The jacks were then released and removed. The contractor then proceeded to complete the remaining riveting which was mostly in the stringers and bracing. The ties at the ends of the bridge were again connected, and the turnbuckles tightened and locked by spot welding them to the threads of the bolts.

The rollers under the pier shoes were no longer required, and were encased in a block of linotype metal poured in a molten state to a height 1 in. above their tops. Since the rollers and the linotype metal acted as a unit, the metal was designed to carry some of the reaction. It undoubtedly picked up some of the load of the steel, for the rollers expanded when the linotype metal was poured, and then contracted with the cooling of the entire mass. The linotype metal, with a relatively small coefficient of expansion, remained almost constant in volume, and therefore picked up a part of the load carried by the rollers. Concrete was then poured around the metal blocks and in back of the shoes until all of the

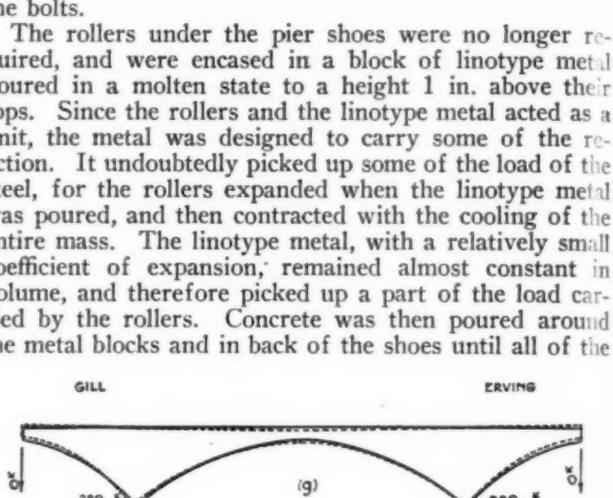


Fig. 5

struts, plates, etc., were covered up so that at present the shoes have the appearance of being supported by the concrete immediately in back of them.

The entire work was designed and executed by the Massachusetts Department of Public Works: Frank E. Lyman, Commissioner; Richard K. Hale and Herman A. MacDonald, Associate Commissioners; Arthur W. Dean, Chief Engineer; and George E. Harkness, Bridge Engineer.

Acknowledgment.—The forgoing is an abstract of a paper presented before the Boston Society of Civil Engineers and printed in the Journal of the Society.

EDITORIALS

Evidence that the Depression in the Highway Field Is Ending

PRIOR to the beginning of the depression in 1929 there were three American highway magazines of nation-wide circulation, namely, "Roads and Streets," "Good Roads," and "Highway Engineer and Contractor." Through the absorption of "Good Roads" by "Roads and Streets," and the cessation of publication of "Highway Engineer and Contractor," only one of the three remains.

"Good Roads" was founded in 1892 and was, therefore, just 40 years old when it was merged with "Roads and Streets."

Our older readers will recall that "Roads and Streets" grew out of "Engineering and Contracting," which was established in 1906, or 28 years ago next January. During that period we have experienced three severe business depressions, from the last of which we are emerging. As evidence of this emergence it may be of interest to add that the present issue of "Roads and Streets" carries about 50 per cent more advertising pages than the previous issue. Moreover this occurs at a time of year when normally there is a decrease in advertising.

Undoubtedly the highway field will experience a more rapid recovery from depression than any other field. The federal appropriation of $400,000,000 for highway construction alone insures a swift return to "normalcy." The remarkable increase in sales of motor cars also will be a big factor in that return, for it indicates that the public is keen to renew its habits of riding. That means a swift return to pre-depression income from gasoline taxes and license fees.

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The Electron-Shell Theory

THE constant emission of electrons from the earth has long been a puzzling fact. Perhaps Einstein's discovery that mass and energy are identical may throw light on this puzzle as it has on another one, namely, the source of the sun's heat. Astronomers are generally of the opinion that a conversion of solar atoms into radiant energy accounts for the sun's heat. Why such a conversion occurs is still unknown. Perhaps gravitative pressure effects the conversion. If so, a similar conversion is occurring in the earth and, in fact, in every mass, the rate depending upon the gravitation pressure.

Heat causes an emission of electrons from atoms. Hence electrons would constantly escape from the earth were it not that the electric attraction of the protons would soon bring the escape to an end. But suppose the electrons reach the earth's surface and the protons remain inside. Then if gravitatative pressure is constantly converting matter into energy, protons are being constantly destroyed. As fast as a proton dies an electron can escape from the earth. This, then, may explain the puzzling fact of electron emission.

This explanation furnishes another one, namely, the existence of the electron-shells that are known to encase the earth. One of these shells is the Kennelly-Heaviside layer at an attitude of about 62 miles. The other is the Appleton layer at about twice that attitude. These two electron-shells reflect radio waves and make long distance broadcasting possible.

Radio echoes discovered by Hals and Stoermer indicate the existence of other electron-shells of vast diameter. The stratification of clouds indicates several more electron-shells at relatively slight elevations. Both auroral displays and the luminescent trains left by shooting stars are most frequent in the region of the Kennelly-Heaviside layer.

The editor has previously called attention to the fact that an electron-shell is often twice as far from the earth's surface as its predecessor, thus tending to form a geometrical progressive series whose ratio is two. This peculiar law may be explained as follows: The electrons in a shell are in motion and their impacts cause radiant waves. A radiant wave from such an electron in shell A is reflected back both by the earth and by electrons in shell B. If an electron in Shell A is not midway between the earth and shell B it is soon driven to a midway position by the pressure of the reflected waves that it has generated, for only in that midway position are their opposed pressures equal. Thus shell A becomes midway between the earth and shell B.

The electron-shell theory is only in its infancy, for not until Marconi sent the first radio message across the Atlantic was such a thing as an electron-shell dreamed of. The theory seems likely to have a profound effect not only upon astronomy but upon meteorology. Tides and displacements in terrestrial electron-shells must occur periodically, and these must cause currents of electrons to flow out of the earth in one region and into the earth in another region. Electron currents in the air must cause air currents. It is the editor's belief that these are more important than heat convection currents. At any rate there are many facts that lead to that conclusion. Weather cycles are explainable in this manner.

▼

Will It Pay to Convert a Branch Railway Into a Highway?

RECENTLY it has been suggested that many branch lines of railways should be abandoned and their roadbeds used for highways for motor vehicles. There are not only financial objections to such a plan, but it is questionable whether abandoned railway roadbeds would prove economically suitable for highways. Not only would those old roadbeds have to be widened and paved, but the railway companies would have to be compensated for at least part of their investment.

Nearly every railway is bonded to the limit, and the mortgages provide a definite ratio between total investment and the total bond issues. Hence if a part of the property of a railway is abandoned, other property must be substituted in order to preserve the equity rates specified in the mortgage. It may be that in many instances a branch line does not earn enough to pay operating expenses. In such cases the bond holders should be willing to permit abandonment of the line. Where this is not the case, a railway would not abandon a line unless it were paid something for it.

There are very few branch railways that are not already paralleled by highways. Hence the economic question is mainly one of relative cost of improving the existing highway and of buying and converting an old railway roadbed into a highway. The editor's belief is that in the great majority of cases it would be cheaper to improve the existing highway.

H. P. Gillette

County and Township Roads

A Section Devoted to the Interests of Those Responsible for Secondary Road Improvement

Cement Bound Macadam

Important Research Now Underway for Low Cost Road Work

By VICTOR J. BROWN

RECOGNIZING the latent, potential possibilities that exist for the development of low cost roads the Portland Cement Association, is scientifically conducting an important experiment in low cost concrete road work. It is expected that out of this experiment which is located near the quarry of the Elmhurst-Chicago Stone Co. of Elmhurst, Ill., will emerge new construction methods, new proposed equipment, and new specifications. The research project clearly indicates that the association recognizes the insistent demand of the "man in the street" for more miles of smooth road for his money. Cement bound macadam is the name the association have given to this genus of surfacing. To date they have learned some definite facts about grouting aggregates with a portland cement — s a n d grout. They are also learning something of value with respect to equipment for building cement bound macadam roads.

To date all of the work on this project has been done within side forms. On some of the sections the usual 5-ton tandem roller, is being used while on others a method of construction is being developed which employs a vibrator and eliminates the roller. From the initial experiment it was readily seen that this method of construction has good possibilities for development. The vibrator has been changed for each section, for one reason or another, and at the present time no definite type of vibration e q u i p m e n t, or method of employing the vibrator can be recommended for general use. However, some very definite facts have been learned about its use and it remains for further experiment to develop an acceptable method of procedure by vibrating.

Objectives—The entire research project has been carefully planned. Attention has been given to each detail after the usual engineering method of the Portland Cement Association. When the project was approved the principal objectives of the investigation included:

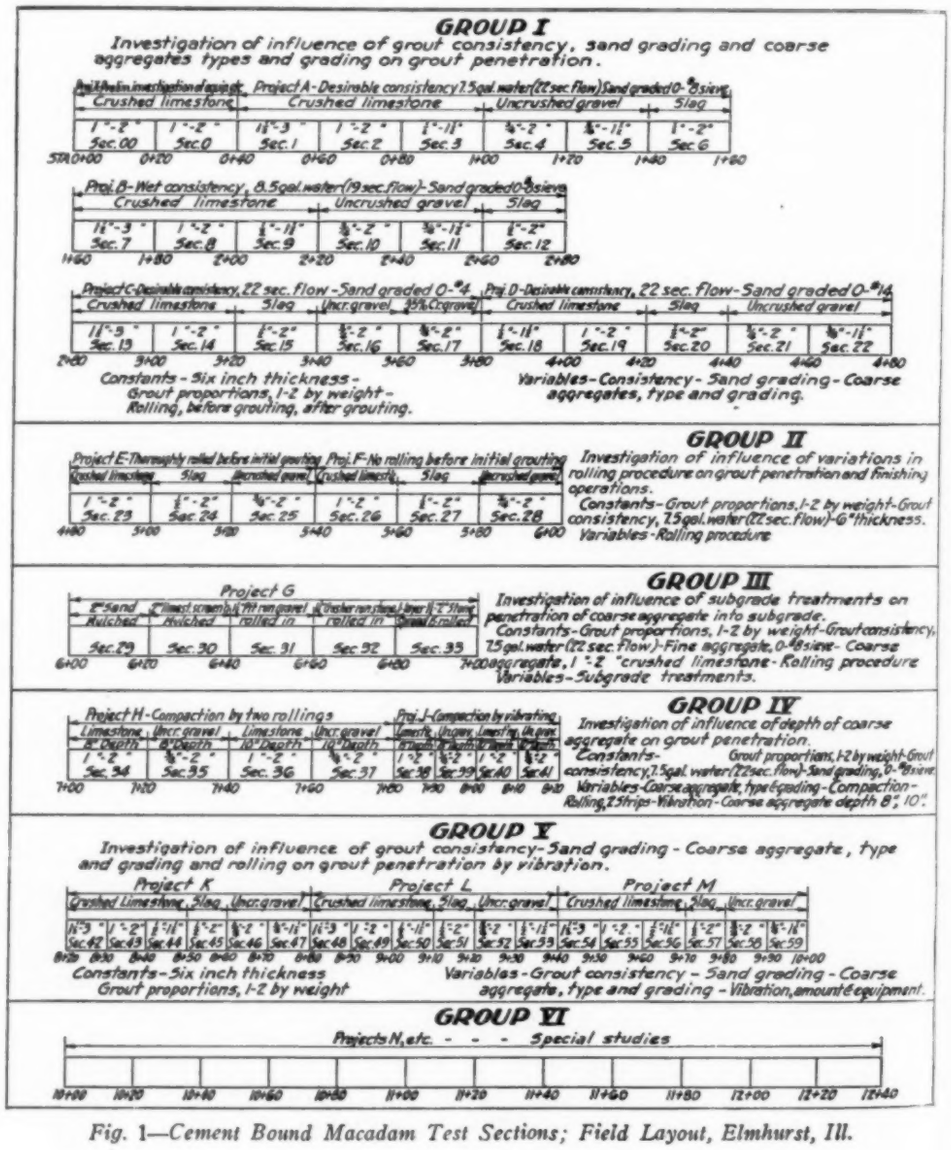


Fig. 1—Cement Bound Macadam Test Sections; Field Layout, Elmhurst, Ill.

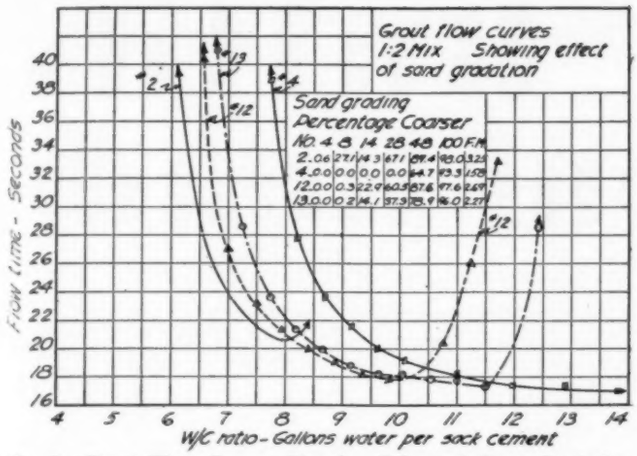


Fig. 2—Grout Flow Curves Showing Effect of Sand Gradation

1. Effect of sand sizes and grading in securing proper penetration of the grout.
2. Effect of various types and sizes of aggregates including crushed stone, uncrushed gravel and slag.
3. How rolling affects penetration of the aggregate and the results of rolling over treated and untreated subgrades.
4. The effect of vibration on penetration of grout and compaction of the pavement.
5. The effect caused by variation of water content and cement content on penetration of the grout.

The entire investigation was divided into five groups of projects each 10 feet wide as follows:

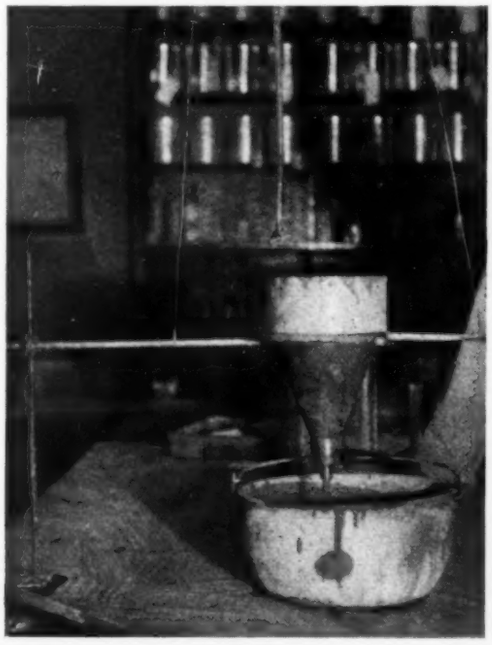


Fig. 3—Flow Funnel Devised for Measuring Grout Consistencies

Group I—Projects A, B, C and D are all 6 ins thick. Penetration of grout of various consistencies into crushed stone, gravel, and slag of various sizes will be studied, as well as the influence of rolling.

Group II—Projects E and F are 6 ins. thick. Study will be made of the effect of variations in initial rolling on grout penetration and on penetration of aggregate into the subgrade. Crushed stone, gravel, and slag were used.

Group III—Project G is a study to determine the effect of various types of subgrade treatment on the penetration of coarse aggregate into the subgrade under initial heavy rolling. Aggregate used was crushed stone.

Group IV—Projects K and L are 8 and 10 ins. in thickness for a study of the effect of depth of aggregate on penetration. One project will be rolled, the other vibrated. Both crushed stone and gravel will be used.

Group V—Projects K, L, and M are all 6 ins. thick. Use of vibration, with and without rolling, to secure penetration of grout and compaction of pavement will be studied. Aggregates will be crushed stone, gravel, and slag.

Group VI—Project N and following will be used for the further development of facts observed during the construction and observation of the preceding projects. These may include details of joint installation; special studies of coarse aggregates; surface smoothness; light

Fig. 4—General View of Experimental Stretch. Rolling Ungrouted Stone on Project G, Sections 29 to 33-A, Inclusive. Five-Ton Tandem Roller Used

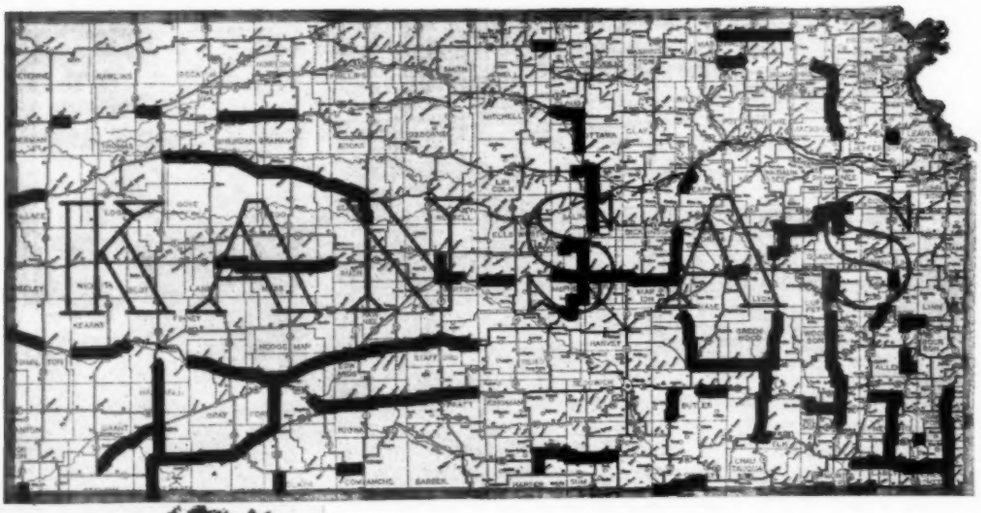
weight rolling; hand tamping with heavy longitudinal float to supplant vibrator or roller, etc.

The accompanying chart, Fig. 1, gives this information in detail.

Grout Flow—The initial work of the investigation required an understanding of the characteristics of the flow of grout. Grout consistencies vary with changes in water content, changes in cement content, changes in sand grading or combination of these changes. Previous experience with water-cement ratios indicates desirable ratios for desirable concrete strengths. This gave the researchers a starting point. After adopting a

Fig. 5—Pouring Grout on West End of Section 19. Grout Flows Out of Chute Hopper Through Several Holes About One Inch in Diameter

Kansas Builds Bituminous Roads



1,600 Miles of in Two Years

THE Kansas State Highway Department, after careful analysis and deliberation, started an extensive program of low cost bituminous road construction. During 1931 and 1932 sixteen hundred miles of bituminous roads were built.

There are a number of important reasons for preferring bituminous paved roads, especially if constructed with Standard Asphalt Road Oil and Stanolind Cut Back Asphalt. These roads are:

1. Low in cost of construction, maintenance and investment.
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3. Serving the greatest number of people with the most miles of paved roads and with the lowest car operating cost.

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Fig. 6—Rolling Grouted Slab About 30 Minutes After Pouring to Smooth Surface and Partially Compact. Roller on Sections 35 and 36

definite sand grading and cement content water was varied for a series of grout tests for the determination of consistency or flow. Adding water only will, of course, when continually agitated, make the cement-sand grout thinner. Flow was measured by the number of seconds required for the grout to flow out of the "flow funnel" through a tube in the bottom ½ in. in diameter by 1 and 2 ins. long. The factors which varied in the grout flow tests were seconds of time and quantity of water. By plotting seconds of time on graph paper as the ordinate and (w/c) water cement ratios, *i. e.*, gallons of water per sack of cement, as abscissa a series of points, corresponding to the series of tests made, will result, through which a smooth curve may be drawn. This curve has been termed a "Flow Curve" for a particular set of conditions. Figure 2 is a series of curves in which the ratio of sand to cement by weight remained constant. Each graph represents different sand gradations. These particular gradings were chosen to show what a wide variation is obtained by using differently graded sands.

It will be seen from a glance at the curves that starting with a thick, soupy grout the time of flow decreases as water content increases. It will also be noted that as water content is increased beyond a certain point that flow ceases entirely. When the grout is poured from the mixer into the "flow funnel" the operator plugs the bottom end of the tube for 5 seconds to eliminate the effect of turbulence on the flow. The plug is removed and the length of time for the grout to flow through the tube is measured in seconds.

By correlating the results of the "flow funnel," in preliminary tests, with the ability of grouts of certain consistencies to penetrate the coarse aggregate it was assumed that the "flow funnel" readings would indicate desirable grout consistencies for use in the research work. A flow time of 22 seconds was considered desirable as a result of many preliminary tests. It will be noted on curve number 12, which is a desirable grout, that the curve reaches a lower point.

While it might casually appear to be beneficial for insurance of penetration to have a thinner grout, previous studies have shown that as the water-cement ratio increases the strength decreases, and also, that the possibility of segregation is enhanced.

Thus the 22-second point was selected because it was found that a grout of this consistency, or viscosity, if one may be permitted to use the term, made from a uniformity graded sand, would result in a strong concrete, yet was not too thick to penetrate the coarse aggregate. The curves in Fig. 2 clearly indicate the value of selecting a proper sand grading for best results.

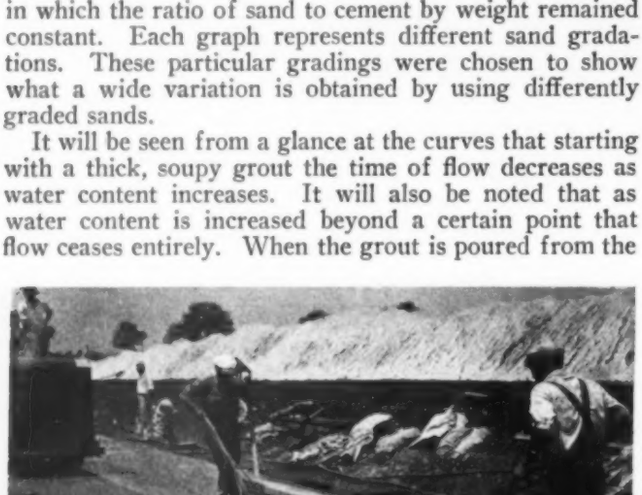


Fig. 7—Hand Tamping After Rolling with Longitudinal Float Just After Rolling and Prior to Final Finishing. Note Notch in Slab at Left Where Test Beam Was Removed

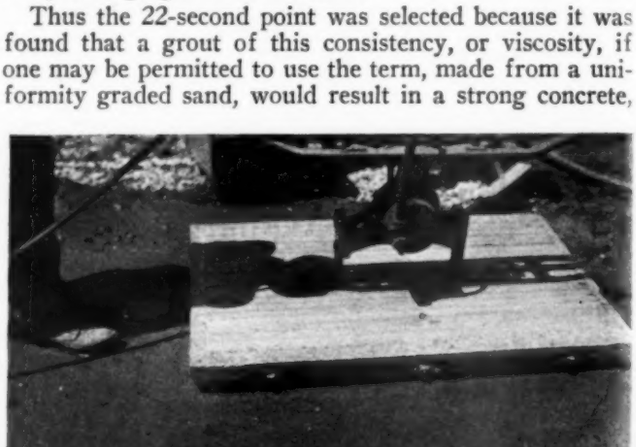


Fig. 8—View of "Puddler" or Vibrator Immediately Following Grouting. This Electric Vibrator Helps to Secure Penetration

Field Procedure—When the forms are set for a particular section, the coarse aggregate is placed and struck off to an even surface. It is next rolled a definite number of times, provided the section is a rolled section. Just before the grout is mixed the aggregate is wetted with a hose for the purpose of lubricating the aggregate to aid penetration. The mixed grout, as specified for the section is poured, allowed to stand for about 30 minutes, and then rolled again but only enough to partly compact and smooth the surface. Excess grout is then squeegeed around, the surface tamped, and finally finished. Excess clear water can be seen running off the surface shortly after the grout is poured and settles. After finishing, the section is cured with wet burlap for 48 hours. The clear water leaving the surface indicates that a water-cement ratio less than that which was mixed, finally results. Indications are that cement-sand grouts have definite optimum water demand.

On those sections on which the vibrator was used no rolling was done. It has been found that rolling pushes aggregate into the subgrade, hence on the 6-in. rolled

sections the aggregate was placed 8 ins. thick in the loose mass, *i. e.*, 2 ins. thicker than the finished thickness. On the vibrated sections this excess thickness was reduced to ¾ in. on the 6-in. finished thickness slabs. Field procedure has also shown that vibration, when accompanying or immediately following pouring of the grout, made possible the use of smaller graded aggregates or thicker grout.

At the same time that the forms for the slabs are prepared, a form is set to separate out a beam for use in a strength test. The beam thus prepared represents the condition of the slab as actually grouted and finished. Seven-day tests have been run on these beams and breaking strengths of 550 to 600 lb. per sq. in. have been obtained. The top side is placed in tension. These 7-day tests indicated no material differences in strengths with the various aggregates that were penetrated. Apparently the loss of water and the elimination of air voids, because of penetration from the bottom upward, are factors contributing to the high strengths.

While grout with a water-cement ratio of 7.5 was being placed small hand holes were made in the aggregate ahead of the spot where the grout was pouring to see if it flowed underneath. In coarse rock and coarse gravel sections was noticed that the grout flowed along the subgrade from 1 ft. to 3 ft. ahead of the grouting. Previous tests showed that in coarse, 1½ in. to 2½ in. aggregates the grout penetrated readily and easily. Just how small the aggregate may be, with aid of vibration, to insure penetration of the grout will be one of the results determined from these experiments.

Practical Application—The value of this research work lies in the ability of the engineer to interpret its results with reference to commercial as well as local aggregates. Many valuable scientific facts have been discovered but their employment is confined to purely theoretical use. Those in charge recognize that their results must be presented so as to cover a wide range of conditions with respect to aggregate and sand gradings in order that they may be used for practically any local condition.

Laboratory conditions cannot be expected to obtain in field work so certain tolerance must be determined within which a reasonably good job will result. A study of the grout flow curves is being made to ascertain within what limits the water content and sand gradation can vary for satisfactory penetration. A study of the field work will indicate the practical minimum limits of aggregate sizes and what sand gradations or grout consistencies may be used with certain aggregates under certain methods of construction.

For example, it may be definitely stated that a grout with a sand gradation of 0 to 8 when mixed in 1:2 proportions with a water-cement ratio of 7½ will be sure to penetrate a 1 to 2 in. coarse aggregate. Penetration and grout consistency can be definitely checked at time of construction. On the other hand a grout made from a sand containing a large percentage of particles retained on a number 14 screen when mixed in 1:2 proportions, and a 5½ water-cement ratio, will not penetrate to the bottom of six inches of ¾ to 1 inch sized coarse aggregate.

Another practical result of these experiments is the records of the amounts of materials used. The resulting "index of quantities" makes it possible to accurately calculate total quantities necessary for a particular job. During the routine of the experimental work, quantities were adjusted to give the desired finished job with different construction methods.

Mixture of Asphalt and Cypress Wood Fibre Used as Flooring

One of the most recent asphaltic mixtures to be developed for bridge floors, warehouse and factory floors, and tennis courts is known as Cypreturf, a patent for which is owned by the Cypreturf Co. of Jacksonville, Fla. The material, which has now been produced for several years, consists of a mixture of ground cypress wood fibre, combined with varying proportions of asphalt and limestone dust filler.

The wood fibre is not a sawdust but is specially ground so that the separate fibres are of considerable length. The binding medium used is Texaco No. 35 asphalt, a material of 30-40 penetration and 160-185° F. melting point. The asphaltic content of the mixture varies from 25 to 35 per cent by weight, and the dust filler from 5 to 9 per cent, according to the uses for which the product is designed. The material is manufactured in a specially designed mixer under a high temperature and pressure so that the fibres are thoroughly impregnated.

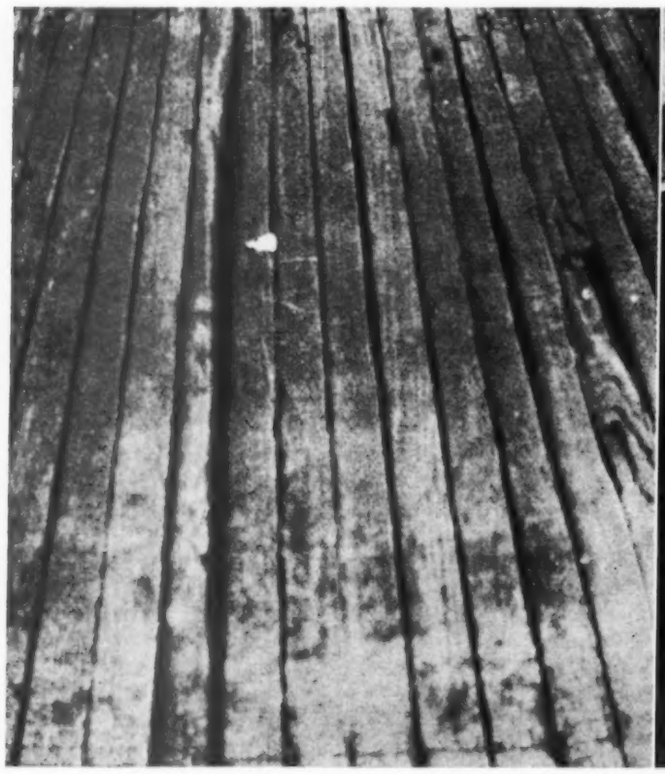
This asphaltic mixture is characterized by a light weight, approximately 30 lb. per square yard per inch compacted, its resilience, toughness and resistance to wear, ease of construction and its stability under extreme conditions. It also has excellent non-skid properties as a bridge floor pavement and is easily and readily patched so that patches do not show.

Old wooden bridge floors are readily covered and vibration reduced to a minimum. Loose planks do not cause the pavement to buckle and cracks above joints are self-healing. On factory and warehouse floors, either concrete or old wooden floor base, results have been satisfactory in reducing noise, vibration and economy of service.

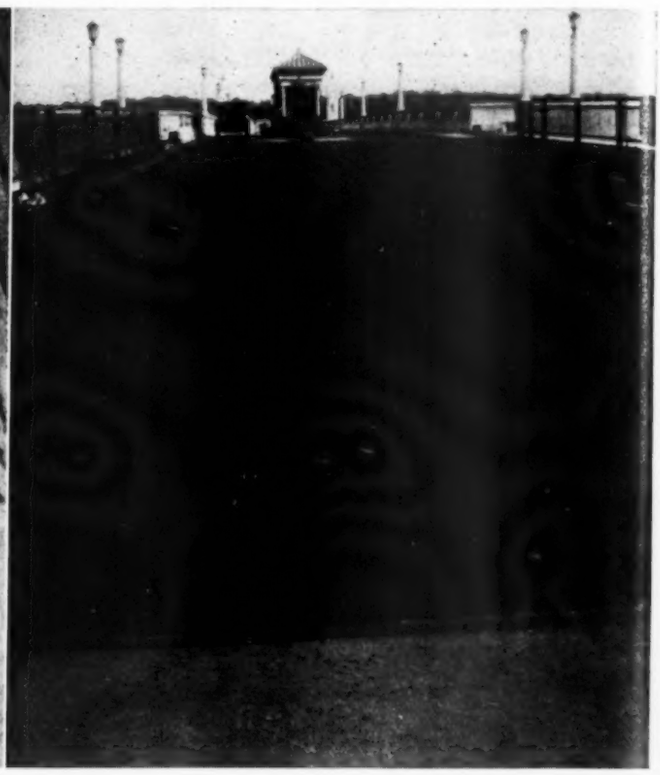
When used in tennis courts, the surface is coated with a green pigment giving a close approximation, both in appearance and texture, to a grass court. An all-weather playing surface is obtained and the cost of maintenance is negligible.

The finished material ready for use is shipped in 200 lb. burlap bags. When laid on wood or concrete base, a tack or prime coating of asphalt emulsion is first applied. The pavement is then spread cold, raked and rolled in the ordinary manner.

A notable example of the use of Cypreturf is seen on the draw span of the St. Johns River bridge at Palatka, Fla. The floor consisted of worn wooden planks which required renewal about every two years at large expense. The 1 in. Cypreturf pavement applied has practically eliminated all rattling and vibration noises and shows no deformation or wear under heavy traffic which stops and starts at the toll house on the pavement. The light weight per square yard does not add materially to the bridge load which is of especial importance on the draw span lift.



Condition of Old Floor Before Paving. St. Johns River Bridge,



Completed Pavement on Draw Span of St. Johns River Bridge

Winter Work on Minnesota Highways Planned

Special plans are being laid by the Minnesota State Highway Department to prolong the construction season well into the winter on all types of work where this is practical. Graveling, grading and bridge work, which are not easily halted by bad weather, have been given a prominent place on the fall program for this reason, according to a bulltin from the Highway Department.

The department has been allotted $10,000,000 for construction work by the Federal government under the National Industrial Recovery Act. Owing to the lateness of the season, one of the problems in handling these funds is to plan work which will provide jobs as long as possible after the beginning of cold weather.

Bridge building can be carried on almost all winter, and present plans call for construction of more than 30 bridges in various parts of the state.

SNOW REMOVAL SECTION

DRIFT PREVENTION — SNOW REMOVAL

Street and Highway Clearing

Snow Removal Method and Equipment on Mountain Highways of California

AS early as 1922 it became evident to the State Highway Department of California that the increase in automobile travel combined with the improvement of the mountain roads would in a few years justify keeping the main through routes open to traffic during the winter months.

Snow Condition on U. S. 40 at Donner Summit.

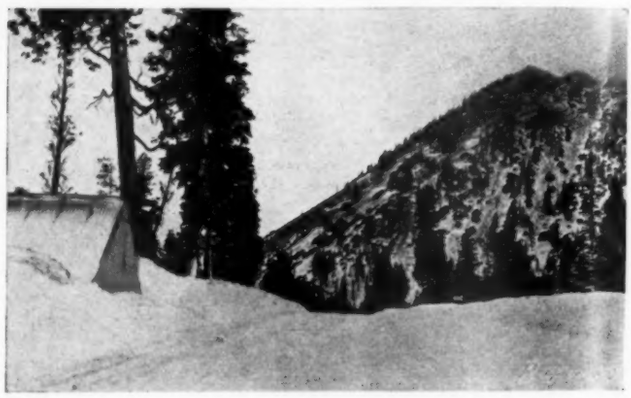
Early Snow Removal Work.—The first special equipment for this work was assigned the Pacific Highway between Dunsmuir and Weed in coöperation with Siskiyou County. Provision was also made for taking care of the occasional heavy storms which might block the Ridge Route between Los Angeles and Bakersfield. These two routes have comparatively light snowfall, although removal work is required each winter on the Pacific Highway where an elevation of about 3,800 ft. is reached.

Nothing special was done on the other routes for several years, except as roads could be opened with the regular tractor and grader equipment, as, for instance, the roads between Redding and Alturas, Redding and Arcata, and Nevada City to Downieville. The principal reason for this was not lack of appreciation of the benefits to traffic, but was due to the unimproved conditions of the mountain roads. It is not possible to handle any great quantity of snow within the limits of a narrow, crooked road. Even if the road is free from snow it is very difficult to keep it passable under California winter traffic conditions unless the road surface is rocked or paved. The next step in the snow removal work, therefore, was a concerted effort to keep certain snow routes open as late as possible in the fall, and to open them as soon as conditions permitted each spring.

Snow Condition on Red Bluff-Susanville Road.

This period gave the organization opportunity to try out various methods of work and types of equipment, as well as gain experience which is so essential to the success of snow removal operations.

In 1929 equipment was allotted to the lateral between Red Bluff and Susanville so that the route was kept open throughout the winter. The road crosses two summits—one at Mineral and the other at Fredonia Summit, which is at an elevation of about 5,000 ft. In 1930 additional equipment, including two rotary shovel type plows, truck mounted, was secured for the Donner Pass route between Sacramento and Reno. This road was opened several times during the winter season, it being closed only one month during the year to traffic. While gratifying to the traveling public, this success was possible only because of the unusually light snowfall and especially favorable winter conditions.



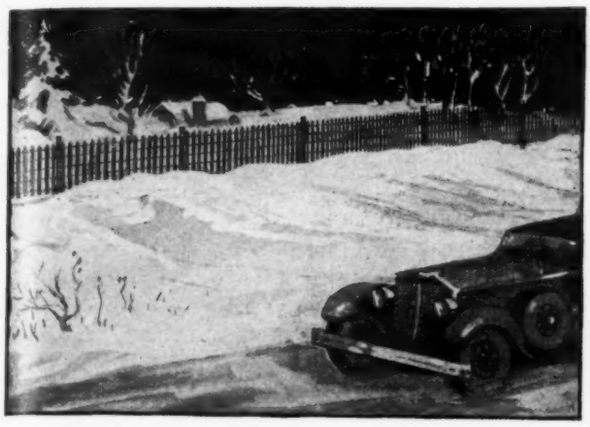
House for Storing Sand, Used in Sanding Roads after Snow Removal.

The completion of construction work during 1931 between Airport and Soda Springs made practical the consideration of keeping this road open between storms during the winter of 1931-1932. Donner Summit is 7,135 ft. above sea level, and extremely heavy snowfall and severe weather conditions may be expected any winter.

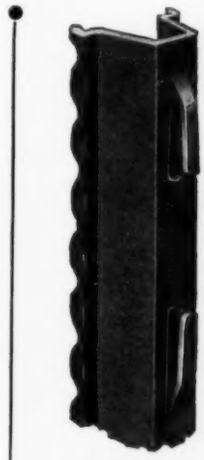
Snowfall Area.—The snowfall area extends from west of Colfax to the California-Nevada State line, a

Bunkhouse and Truck Shed at Donner Summit.

CONQUER SNOW
with these Sturdy Steel Posts



AMERICAN
SNO GARD STEEL POSTS



IDEAL U POSTS
SHOWING DOUBLE LOCK FEATURE

SNOGARD STEEL POSTS are formed from special steel into a rounded back, flanged channel shaped post, and equipped with riveted hooks to support wood slat snow fencing. These hooks cannot turn from vibration while driving—an exclusive feature. Furnished in standard lengths and various weights.

IDEAL U POSTS are furnished in five lengths and in four weights with or without anchors. Posts are painted Willow Green after forming.

Each post has five tongues—one for each of the five cables in Snow Fencing. These tongues securely hold the cables. When desired posts can be furnished with the top tongue pointed down, forming a Double Lock, making it unnecessary to bend the tongues or use tie wires to lock fencing to posts. Fencing is easily removed without the use of tools. No clamps or wires to fall in the field when removing fencing.

AMERICAN GIDE-RITE SIGN POSTS

Mark the Roads with
AMERICAN GIDE-RITE SIGN POSTS

Gide-Rite Steel Posts offer a very efficient method of supporting road signs. Made from special steel and formed into a strong channel with wide flanges on the face to support signs. Furnished with a hot galvanized or painted finish in five standard weights. We will gladly furnish full details and prices on request.

1831 MORE THAN 100 YEARS of PROGRESS IN WIRE MAKING 1933

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SUBSIDIARY OF UNITED STATES STEEL CORPORATION
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total distance of nearly 90 miles. The elevation varies from 2,500 ft. at Colfax to 7,135 ft. at Donner Summit, and 5,125 ft. at the State line. Records of snowfall during the past 60 years show a maximum season's fall of 783 in. in 1879 to 1880, a minimum of 145 in. in 1880 to 1881, and 402 in. as an average winter fall for the entire period. A study of these records shows that some 20 to 25 ft. of snowfall may be expected even in moderate winters.

There are records of snow falling at a rate of 8 in. an hour at the higher altitudes and, if such a snowfall is accompanied by a wind of high velocity and low air temperatures, the situation becomes hazardous for anyone stranded in that area. From Colfax to Truckee accommodations for the traveling public are limited, particularly during the winter season. Although Emigrant Gap and Norden are railroad stations and there is a hotel at Soda Springs, accommodation could naturally not be expected for any large number of snowbound travelers.

Snow Fence, Picket Type.

Start of Snow Removal on Donner Pass Road.—An appreciation of these facts caused the Maintenance Department of the Division of Highways to approach the problem with care and without undue optimism as to the ease of the task. Information had been collected and experience gained, anticipating the time when the work might be undertaken with fair prospects of success. When the plan was first considered, the road was of a comparatively low standard. It was unsurfaced, with sharp curves, steep grades, and many miles of narrow roadway. Any attempt to keep such a road open was impracticable, since even if the snow was removed it would not have been feasible to maintain the surface in condition for traffic.

Each season has seen an advance in the reconstruction of this road to higher standards. The plans of each project were reviewed with the thought to provide a road section most favorable for snow removal work. Wherever possible the grade was established sufficiently above the adjoining surface so that advantage could be taken of the scouring action of the wind. Where it was necessary to go through cuts, the normal ditch section was widened and storage space thus provided for the snow which would be pushed off the traveled way.

This widened ditch section also provides additional drainage when the snow melts, thus aiding in the upkeep of the road. The surfacing placed on the road must be adequate not only to carry traffic, but support the heavy snow removal equipment with a minimum of winter maintenance. In addition, the shoulders beyond the pavement must be of crushed rock to permit equipment to operate off the pavement when clearing snow.

Housing and Shop Facilities for Snow Removal.—Snow removal work requires not only proper equipment and organization, but also proper facilities for caring for both men and equipment. The cold weather and constant strain from removing wet or frozen snow causes frequent breakdowns of equipment. Lack of repair facilities and spare parts at the scene of action means a snow-blocked road. This side of the work has been brought forcibly to attention during several storms of the past two winter seasons.

The housing and shop facilities to carry on the work on Donner Pass Road include the following:

At Colfax there is the regular maintenance station, which is headquarters for the Maintenance Superintendent. There is a standard bunk house and office and an 8-stall truck shed with oil house and blacksmith shop.

At Yuba Pass Station, three miles east of Emigrant Gap, there is a truck shed 40 ft. by 143 ft. in size and a bunk house capable of housing 16 men. The truck shed is sealed and a steam heating plant installed to heat not only the bunk house but the truck shed as well. Provision for making minor repairs to equipment is included in the truck shed layout at this point.

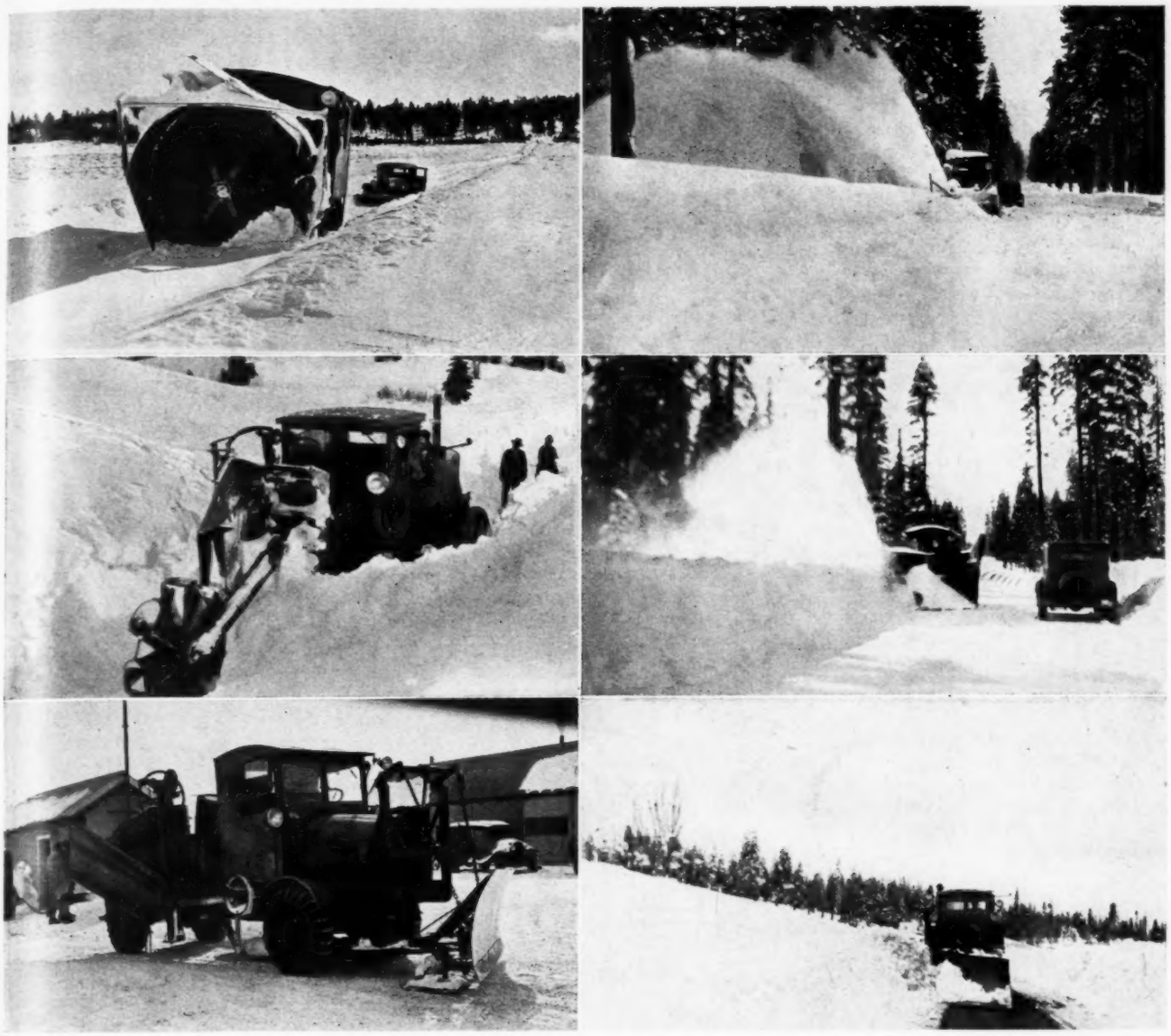
The main headquarters of the snow removal work is located at Donner Summit about 17 miles from the Yuba Pass maintenance site. The truck shed at this point is of the roundhouse type and includes a repair shop with pits and tools to handle major equipment repairs. A 16-man bunk house, similar to the Yuba pass layout, is connected to the truck shed by a covered passage. Both of these buildings are constructed to withstand the coldest weather and are steam heated.

At the Truckee Maintenance Station there is a 30 ft. by 100 ft. truck shed with steam heating plant, a standard oil house, and dwelling which is used as a bunk house.

The snow removal on the section of road from west of Colfax and east to Airport is handled from the Colfax site. The crew at the Yuba Pass Station removes snow from Airport to a point midway between that station and Donner Summit. The outfit at Donner Summit handles the section from nine miles west of the summit to the junction with the Tahoe City road, a short distance west of Truckee. The Truckee crew removes snow on the section of road immediately west from Truckee to the State line and, in addition, takes care of the road between Truckee and Tahoe City, as well as a portion south of Tahoe City on the west side of Lake Tahoe. A truck shed and living quarters are also available at Tahoe City as an auxiliary to the Truckee layout.

Snow Fence, Braid Type.

Equipment Starts with Storm.—Effective snow removal work requires that the equipment start with the storm and continue until the storm has ceased and the road is clear. This means that the crews must be ready



Types of Equipment Used in Snow Removal Work on California Mountain Highways. Upper Left: 9 ft. Blade Rotary. Upper Right: Auger Blower Type Rotary in Operation. Middle Right: Shovel Type Rotary. Middle Left: Blade Type Rotary, Tractor Mounted. Bottom Right: Speed Plow with Wing Attachment. Bottom Left: Speed Plow with Wing Attachment.

and equipment serviced, all in readiness for continuous operation for the duration of the storm. This fact accounts for the care and expense taken for the comfort of the men and facilities for housing and care of equipment.

Early in November, 1931, two sets of gates were erected across the highway—one at Airport and one just west of Truckee. Watchmen's shanties were in place at these locations and telephones installed. With the first sign of a severe storm, the gates are closed to all traffic and the equipment is lined up and ready to start.

While the severe conditions on Donner Summit require special equipment and organization, modern equipment is also maintained and operated as required at a number of other locations in addition to those mentioned. Snow is cleared on the main line of the Pacific Highway, the Ridge Route south of Bakersfield, the Redwood Highway east of Crescent City, and the State Highway between San Diego and El Centro, as well as the Red Bluff-Susanville, Redding-Alturas, Downieville and Trinity laterals.

General Summary of Snow Removal Operations in Mountain Areas.—During the winter of 1931-32, the Maintenance Department removed snow on 2,480 miles of road at an average cost of $124 per mile. Being somewhat under-equipped at that time, an additional $175,000 worth of equipment was purchased during the fall of 1932 and, as a result, removed snow on 3,000 miles of highway during the 1932-33 season at a cost of $104 per mile. The season's snowfall on these roads ranged from 48 ins. to 533 ins.

The snow removal extends generally above the 2,000-ft. level, though at times freak storms give snow at much lower elevations. This, however, is generally removed with the regular routine maintenance equipment. A considerable portion of the mileage cleared ranges from the 5,000-ft. level to well above the 7,000-ft. At these higher elevations, the road is under control—that is, gates are placed at the lower elevations with watchmen, who regulate traffic in accordance with the severity of the storm. Maintenance stations are located along these snow ruotes at 30-mile intervals, with accommodations for both men and equipment. Usually, a steam plant provides heat for the bunkhouse, as well as the truck shed. This has been found a great advantage in clean-

ing up the equipment, so that it may be properly serviced. Sufficient men are available at these locations to operate the equipment on an 8-hour and not to exceed 12-hour shift.

Before the season opens, the edge of the road is generally outlined with long marker poles, the top 2 ft. of which are painted orange to provide a contrast with the snow.

At the higher elevations, the Department usually requires three one-way speed plows mounted on 3½ to 5-ton F. W. D. trucks, supplemented with a truck-mounted rotary. The speed plows start with the storm and continue throughout its duration. The rotary begins operation as soon as sufficient snow has been bladed to the side by the speed plows. At the expiration of the storm, roads are sanded wherever necessary, though it is insisted at all times that motorists be equipped with chains before attempting to travel these roads. Rotary units in common use include the auger-blower type, shovel type rotary, and the blade type, both truck and tractor mounted. At the present time, the Department is experimenting with a large diameter blade type rotary, the capacity of which should exceed that of the present types.

The standard picket type snow fence has been found a material aid in the work and the amount used increased annually.

During the past season of 1932-33, the Department expended approximately $312,000, distributed as follows:

	Per Cent
Materials and supplies	18.8
Service and expense	9.
Salaries and wages	36.6
Equipment rental	35.6

The equipment is handled through the Equipment Department, which assesses a daily rental for each unit.

We are indebted to T. H. Dennis, Maintenance Engineer, State Division of Highways, for the above information.

Subcontracting in Procurement of Materials

A recent memorandum issued by the Bureau of Public Roads to its District Engineers, outlines as follows the extent to which the procurement of materials entering into highway construction would be considered as subcontracting:

"The special provisions for highway projects financed in whole or in part under Section 204 of the National Industrial Recovery Act require the contractor to perform with his own organization and with the assistance of workmen under his immediaate superintendence 80 percent of the value of the work embraced in the contract.

"The purchase of sand, gravel, crushed stone, crushed slag, batched conccrete aggregates, ready mixed concrete and/or any other materials produced at and furnished from established and recognized commercial plants shall not be considered as subcontracting under these provisions.

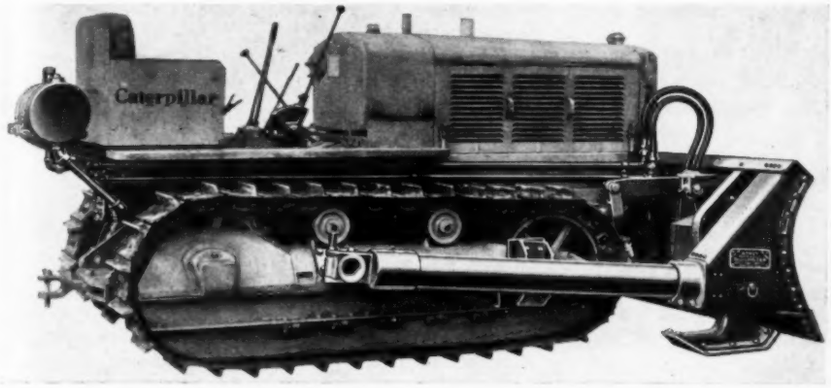
"The hauling of all such materials from points of production to batching plants, mixing plants, or directly to the work, except when done by rail, water, or by the contractor's own equipment, shall be considered as subcontracting. If batching plants are set up at rail or water delivery points and materials in part supplied to such plants by rail or water, the remaining materials required may be hauled from points of production to such batching plants without such hauling being considered as subcontracting.

New Equipment and Materials

New Hydraulic Bulldozer

To meet the need for a bulldozer that can be mounted on the new models of Caterpillar tractors and readily dismounted when the tractor is used for service with hydraulically operated or other types of dump trailers, the Athey Truss Wheel Co., 5631 West 65th St., Chicago, Ill., has just announced the Athey hydraulic bulldozer.

The Athey hydraulic bulldozer is an exceptionally compact and rugged unit, adapted to either the Caterpillar Thirty-five or Fifty tractor. It is claimed to incorporate a number of unusual advantages that mean fast, clean operation with exceptional durability and flexibility.



The Athey Hydraulic Bulldozer

The blade is of the moldboard type and can be furnished with detachable end cutting edges when specified. It can be quickly and easily converted from a full power double acting or floating blade to a "full floating" blade by a simple adjustment of the operating bar pins. This makes available for digging in exceptionally hard soil, a controlled blade; and in the same unit, a "floating" blade when conditions require this type of operation.

The blade and operating linkage of this Athey bulldozer are mounted and carried on the track and roller frame assembly of the tractor. An equalizer assembly permits the full movement of each track assembly, without materially changing the level or movement of the blade. It also provides a flexibility between the tractor and the bulldozer which eliminates twist and strain, adding materially to the life of both units. This bulldozer has the exclusive feature that it is entirely mounted on pads provided for that purpose by the tractor manufacturer.

Control of the Athey bulldozer is from the tractor seat, with "finger-tip" selection between the various operating positions of the control level. Movement of the blade has been worked out to the ideal speed. . . fast enough to match the maneuverability of the tractor without sacrificing accurate and positive control. No linkages, beams or hoists obstruct the operator's vision. The Athey is self-contained and compact.

The hydraulic pump is a very highly developed product and has such exclusive features as being equipped with a clutch so that it may be disengaged when not required, or for wagon service; a combination of an automatic relief and by-pass valve, which instantly and automatically relieves excessive operating loads and stresses. It is a compact self-contained unit, equipped with an air cleaner to assure uninterrupted service.

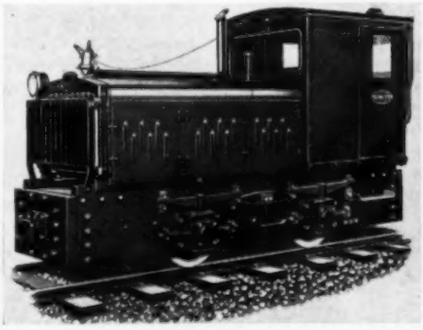
The Athey bulldozer is exceptionally easy to install. It is not necessary to drill or tap any holes or alter the tractor in any respect. Two men can easily make the original installation in from 2 to 2½ hours, with subsequent mountings requiring only a few minutes.

▼

New 10-Ton Diesel Powered Locomotive

The Fate-Root-Heath Co., Plymouth, O., builders of Plymouth locomotives, announce a new 10-ton diesel powered locomotive. The 6 cylinder power plant is of the solid injection type with a 4⅞-in. bore and a 6-in. stroke developing 95 HP. at 1200 R. P. M.

Two types of drives are provided. Locomotives are equipped with mechanical gear drive in sizes from 6 to 60 tons and diesel electric drive in sizes from 25 to 60 tons. The patented Plymouth 4-speed transmission incorporated into these latest locomotive developments makes it possible to apply the same power and speed in either forward or reverse movement.



One of a Series of Plymouth Diesel Locomotives

Several decided improvements have been included in the Plymouth chassis. Side and end frames are made from extra heavy steel to insure perfect alignment. Semi-elliptic springs are both side and cross equalized, insuring easy riding over rough and uneven track, practically eliminating any possibility of derailment. Cabs and canopies are made from heavy gauge sheet steel and are fully enclosed.

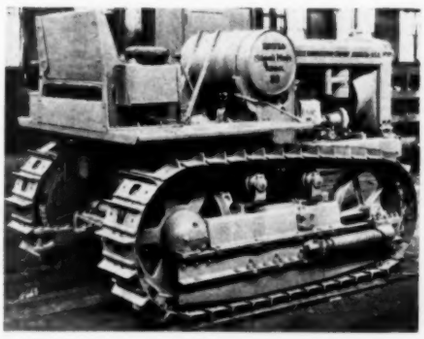
Plymouth Locomotive Works, Plymouth, O., was one of the first companies to successfully manufacture a diesel powered locomotive. A large number of these locomotives have been in operation for the past several years, all of which have made excellent records both as to economy and service.

▼

New Bates Diesel Oil Burner Tractor

A new track type tractor for the burning of low gravity fuel has been announced by the Bates Manufacturing Co., Joliet, Ill. This tractor develops approximately 38 HP. on the drawbar. It is powered by a 4-cylinder Waukesha Hesselman oil burning engine. This engine is manufactured under American rights to the European Hesselman patents.

The Waukesha Hesselman engine used in this Bates "35" burns any fuel that the ordinary Diesel engine will handle, and some fuels that the ordinary Diesel engine cannot utilize.



New Bates Diesel Oil Burner Tractor

The fuel is metered into the engine with a high pressure Bosch ignition pump injecting through Hesselman injectors which throw the fuel into a rotating air stream in the cylinder. Here the fuel is intimately mixed with air. At this point the Waukesha Hesselman ignites it through a special spark plug. One of the patented features is that it keeps the mixture ratio in the zone surrounding the spark plug always within the limits for instantaneous combustion independent of the engine load or speed.

This feature of being able to incorporate spark plug ignition with low gravity oil pump fuel injection does away with the necessity of employing an auxiliary engine

to start the main power unit. In fact, it is stated, this engine can be started by a hand crank with no more difficulty than starting the ordinary gasoline engine.

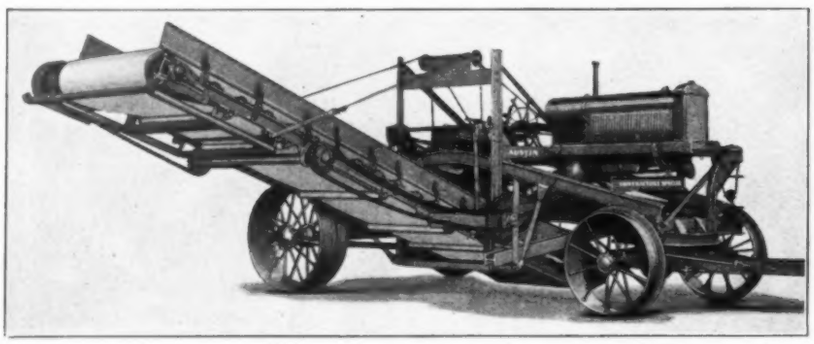
In addition due to always burning all the fuel metered into it at every stroke the motor runs without any more vibration than ordinary gasoline engine. This Bates "35" oil burning tractor is equipped with either 12-in. or 14-in. wide tracks and has three forward speeds: First 1¼, second 2¾, third 3¾, and reverse 1¾ miles per hour. The dimensions of the tractor are: Length, 120 in.; height, 70 in.; width, 72 in.; ground clearance, 12 in.; drawbar height from ground, 16 in.

These Bates low gravity oil burning tractors are now in production in the Joliet plant after nearly a year of experimentation in bringing the product up to a practical operating status.

They retain the same characteristics as the gasoline motored tractor having full clutch steering without differential and swinging drawbar mounted ahead of sprocket wheel center to offset side draft. The swinging crawlers react entirely on a chassis frame without any attachment to the motor and adequate anchoring is incorporated to insure no side springing of crawler frames.

New Austin Special Elevating Graders

According to The Austin-Western Road Machinery Co., Chicago, their new Austin contractors' special elevating graders are better balanced, have greater flexibility, and their capacity output exceeds that of their previous models. The various improvements and refinements of design are many.



New Hydraulic Austin Contractors' Special Elevating Grader

Both plow and carrier are operated by hydraulic (oil) power controls which consist of but seven moving parts, and these always work in oil. A cross-over drive chain on carrier prevents injury to both equipment and wagon operator alike. Carrier head drum of one-piece steel is covered with vulcanized rubber lagging to reduce wear. This drum may be exchanged, when that becomes necessary, for a new one, credit being allowed for the old drum. This eliminates delay and necessity for lagging drum in the field.

To assure flexibility and balance, rubber mountings and cushions are provided at strategic points in the main frame. An arched H-beam frame retains the true arch so necessary, to provide both extra clearance for load on carrier and to keep the center of gravity of the machine at the lowest possible point.

The front rails of this arch are widely separated and mounted on a spring platform which permits a greater vertical and horizontal oscillation of front end. Front wheels can be turned at greater than right angles for quick and easy turning of the machine.

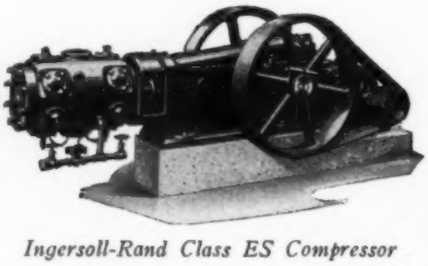
Carrier is equipped with anti-friction bearings throughout, and is provided with an automatic spiral pan cleaner which prevents dirt from clogging and acting as a brake on the belt. Ample power is provided for running the belt. The 42-in. machine is equipped with a Buda K-325 6-cylinder removable sleeve motor, developing 49 HP. at 1200 R. P. M., and the 48-in. machine is equipped with a Buda K-369 6-cylinder removable sleeve motor, developing 53 HP. at 1200 R. P. M. The motors can be equipped with battery, starter and distributor ignition; head and tail lights can also be provided for night work.

The 48-in. machine is provided with an extensible rear axle which can be extended 18. in. to increase the stability of the machine when extra long carriers are used.

New Compressor

A new single-stage, belt-driven compressor designed for heavy-duty service is announced by Ingersoll-Rand Co., 11 Broadway, New York. It is designated the Class ES. It has one horizontal, double-acting cylinder and operates at moderate speeds. It is available in sizes from 10 to 125 HP., and for discharge pressures from 5 to 150 lbs.

The machine is suitable wherever full-load, continuous service is required and wherever power cost is an important consideration. It will give economical standby service for large compressors whose full capacity is not always needed. It is well adapted for use in isolated plants where there is little supervision, for all applications where oil in the discharge line is objectionable, or for installations where a future change in pressure conditions may call for a change in cylinder size. It will satisfactorily handle poisonous or inflammable gases, or any others that must be handled without leakage.



Ingersoll-Rand Class ES Compressor

Low air speeds and small pressure losses obtained by liberal design of air passages and valves insure maximum economy. These features and effective water jacketing also insure low air temperatures, which simplifies lubrication problems and lengthens the service life of valves, cylinders and piston rings. A double row of Timken tapered-roller bearings on each end of the crankshaft reduce friction, make bearing adjustments unnecessary for a long time, and provide rigidity against all strains. Regulating equipment suitable for any conditions of service can be furnished.

Form 3063, available at any Ingersoll-Rand office, contains complete details regarding the ES compressor.

New Rear Crawlers

The Marion Steel Body Co., Marion, O., has recently gone into production on a complete line of Marion-Henneuse rear crawlers, designed by C. A. Henneuse. This crawler is adaptable for use on industrial tractors, power dump wagons, and graders.

Some of the features that make for heavy load carrying capacity, low original cost and economical operation are:

Model HD Rear Crawler

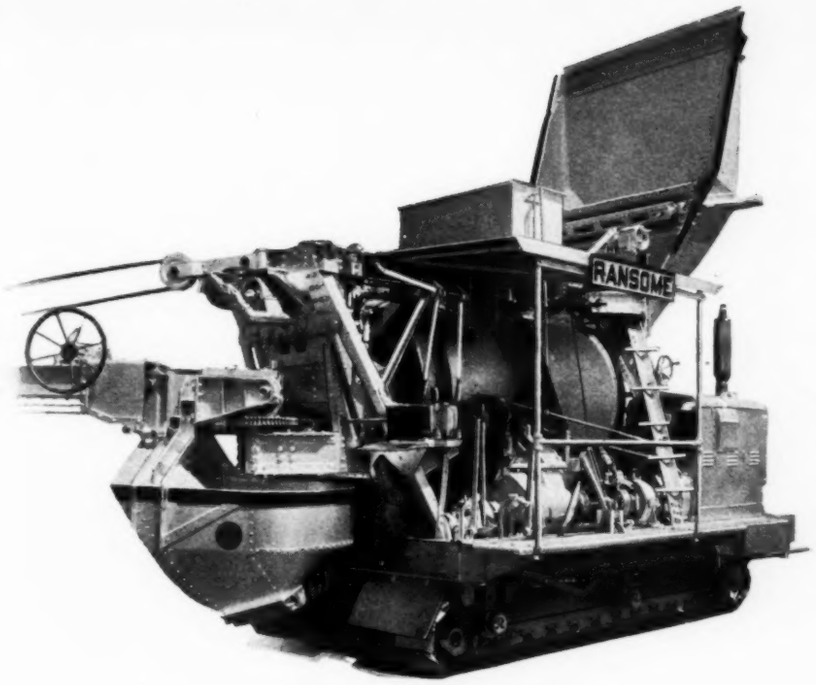
Removable rim sprocket; integral link and tread plate of special alloy steel; removable carburized steel bushings; floating pins; track chains of alloy steel cast integral with tread specially heat-treated; drive sprocket of special high carbon alloy steel, 12 teeth with 6½-in pitch.

Dimensions of Model HD, illustrated, are: length over all, 75 ins.; length on ground, 50 ins.; width of tread, 12 ins.; width of crawler over all, 64½ ins.; total area on ground, 1200 sq. ins.; weight of crawlers, per set, 2650 lbs. Speeds variable with different tractors.

Adaptable to 1-30 and 20 Industrial McCormick-Deering, C. I. Case, Fordson, Allis-Chalmers U, 18-28 Oliver H. P., Twin City K. T. and other tractors of comparable size.

Dual Drum Paver

A dual drum paver has been brought out by the Ransome Concrete Machinery Co., Dunellen, N. J. The outstanding feature of this new equipment is a paver having two standard 27-E size drums built end to end and a power operated transfer chute passing the concrete from the first drum



Ransome Dual Drum Paver

into the second. This power operated transfer chute is primarily the only additional mechanism that has been added to the standard 27-E to get high output paver. Two standard 27-E batches are mixed at the same time.

The dual drum has the same overall dimensions as the standard 27-E Paver except that it is longer, and a longer boom may be used. Standard power loader, standard boom and bucket, standard water tank and standard crawler construction are used. The water control is accurate. The tank is not affected by grades, or stopping and starting the paver, while the tank is discharging.

During the past year Ransome engineers have been making careful tests and observations of their dual durum pavers in operation in several different states. It is stated that the Ransome dual drum paver steps up the output from 50 to 66⅔ per cent or more above the production of the standard 27-E paver.

A bulletin giving a detailed description of the dual drum paver may be secured without charge by writing to the Ransome Concrete Machinery Co., Dunellen, N. J., or to the nearest Ransome distributor.

New Device Indicates Exact Position of Motor Grader Blade

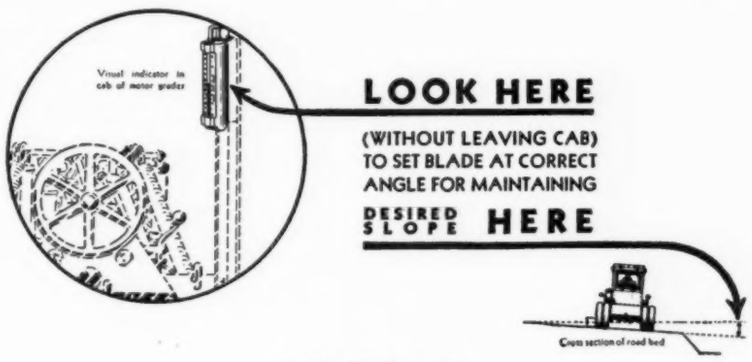
Serving as a tell-tale signal, whenever blade departs from proper cutting position, the new Austin grade-ometer gives the operator instant warning and indicates precisely just what adjustments are necessary. Blade can be set to cut and constantly maintain a flat or sloping surface as easily as a motorist governs the speed of his car.

According to The Austin-Western Road Machinery Co., Chicago, Ill., the device is particularly useful for securing accurate grades when maintaining dirt or gravel roads, and is most dependable for use on shoulder, sub-grade, oil-mix and retread work.

The principle of operation is very simple: A calibrated gauge or indicator mounted in cab is fitted with a U-shaped glass tube that is partly filled with a red, temperature-resisting fluid; only part of the tube is exposed to view. Down in the blade supporting circle, a similar U-shaped arrangement is employed consisting of reservoirs and piping that are likewise partly filled with the same fluid. Two air-filled pipes connect the indicator in cab with the reservoirs mounted in the circle.

When circle and blade are in level position, indicator registers zero. When heel or toe of blade is raised or lowered, the liquid flows from the bottom of one reservoir into the other, raising the column of air in one pipe and lowering it in the other. This unbalanced air condition causes the red fluid in indicator to rise or fall.

Indicator is calibrated both in degrees and inches per foot and accurately shows the slope being cut by blade.



Austin Grade-ometer

Recent United States Patents Relating to Roads

Compiled by Patent & Technical Information Service, 1336 New York Ave., N. W., Washington, D. C.

JULY 4, 1933

1,916,222. **Road Machine.** James B. Jarmin, Dallas, Tex., assignor to Servis Equipment Co., Dallas, Tex. In a road machine, a longitudinal pipe reach, a front axle mounted in ground wheels, a support carried by the front axle and secured to the front end of the reach, a surface working tool carried by the reach, an elbow secured to the lower end of the elbow, a rear axle connected with the support, rear ground wheels carrying the rear axle, and a platform connected to the elbow above the support and the rear axle.

1,916,531. **Cement Loader, Bag Counter, and Indicator for Batch Mixing Apparatus.** John F. Robb, Cleveland Heights, O. In a machine of the class described, in combination, a device for elevating bags of cement, operating means therefor, and means controlling said operating means so that the elevating device will carry a predetermined number of bags of cement to a dumping point, then stop, the predetermined number of bags carried to the dumping point representing a measured batch for a batch of concrete aggregates, and means co-operating with said elevating device for counting the measured batches handled thereby, and means for counting each bag of cement brought to the dumping point by the elevating device.

1,916,563. **Construction of Concrete Pavements.** Walter S. Edge, Pittsburgh, Pa., assignor to National Steel Fabric Co., Pittsburgh, Pa. Apparatus for producing a joint in concrete, comprising a supporting framework to be positioned over a concrete surface, a guide member, and means for loosely supporting the said member upon the framework for vertically sliding movement to permit said member to rest upon the concrete.

1,916,620. **Pavement and Paving Unit.** Warren Johnson, New Orleans, La. A pavement comprising a plurality of polygonal slabs, upper and lower tongue members formed with the sides of said slabs and disposed in staggered relationship, said tongue members being

slightly less than half the thickness of the slab, the upper tongue members being formed with the upper portion of the slab and the lower tongue members being formed with the lower portion thereof whereby to form recesses with which interlocking engagement is made by alternate tongues, the upper tongues of one slab being slightly spaced from the lower tongues of the next adjacent slab and being formed with openings extending vertically therethrough, and a plastic binder forced into said openings and in the spaces between said tongue portions to produce a solid joint.

1,916,631. **Paving Tile.** Henry E. Muchnic, Atchison, Kans., assignor to The Locomotive Finished Material Co., Atchison, Kan. A metallic tile comprising a flat plate of polygonal shape, the perimeter of the plate having a continuous depending flange, while the bottom of the plate is provided with transversely disposed intersecting flanges, with the inner face of the perimetric flange and said intersecting flanges adjacent their lower marginal edges having laterally disposed enlargements with oppositely beveled faces to provide a lower wedging surface and a locking upper surface adapted to be pressed into a roadway surface; the tile being provided with paving material receiving openings having side walls converging toward the bottom of the plate, and depending flanges on the plate bottom about said openings.

1,916,796. **Road Rail Form.** Harold L. Hirschhorn, New York, N. Y., assignor to Standard Steel Sections, Inc., New York. In a road rail combination, a rail member having a web portion and a base portion with a stake opening therein, a buttress channel member having a stake opening therein, said buttress member joining said web and base portions to reinforce said web portion, and said buttress member comprising a horizontal portion and a leg portion disposed at an angle to the horizontal portion, the horizontal portion being substantially spaced from the base portion and secured to the web at a top portion only of the web, the leg portion secured to the base, a stake passing through the respective stake openings of the buttress member and the base, the arrangement being such that the leg portion is substantially spaced from the web portion to provide a substantial cut-out opening there between, said horizontal portion of the buttress channel member being channeled in vertical cross-section and said leg portion of the buttress channel member being channeled in horizontal cross-section.

1,916,887. **Dummy Joint Cutter for Concrete Pavements.** William Thomas McClain, Los Angeles, Calif. In an apparatus for cutting grooves in a road surface, the combination of: a frame comprising a pair of horizontal bars adapted for contact with said surface in spaced relation to a selected line; a cutting member associated with said frame; rollers on said cutting member adapted for movement on said bars for supporting said cutting member; and guide rollers on said cutting member operable in the space between said bars, said guide rollers contacting with said surface to equalize the pressure on said surface during the grooving operation.

1,917,130. **Subgrade Planer.** Harry L. Kistler and Peter J. Trompeter, Jr., Peru, Ill. In combination with a road building machine, a subgrade planer comprising a transverse frame positioned in front of the forward end of the road machine, bars pivotally carried by the frame extending upwardly and in rearwardly converging relation therefrom and pivotally attached to the machine for advancing the frame ahead of the machine, means on the opposite ends of the frame for traveling on the spaced forms at opposite sides of the road, and planer blades carried by the frame and extending downwardly therefrom for engagement with the subgrade to cut and level the same.

JULY 11, 1933

1,918,099. **Road Marker.** George R. Hanks, Clinton, N. J., assignor to Taylor-Wharton Iron and Steel Co., High Bridge, N. J. A road marker comprising a unit cast head and shank having co-operative openings, the structure having the characteristic that portions of the head are angularly disposed with relation to its flush bearing surface and that the openings of the head are radically inclined in coincidence with the angle so that spikes or the like driven fastenings will be guided in positive fashion by said openings so as to intersect in the opening of the shank.

1,918,103. **Line Marker.** Everett H. Hollingshead, Dayton, Tex. In a marking apparatus, a supply tank, a discharge container, a valve operable to control the flow of liquid from said tank, an overflow line for said container, a cutoff valve below said container to prevent escape of liquid therefrom, and a discharge nozzle below said valve and adapted to contact the surface being marked, said nozzle including a block of rigid material with substantially thick walls inclined rearwardly and having a passage therethrough for marking material.

1,918,155. **Road Surfacing.** Edwin C. Wallace, Newton, Mass., assignor to Warren Brothers Co., Cambridge, Mass. The method of surfacing roads and the like which includes applying to surface to be covered, before any stone or other mineral matter is applied thereto, a covering of bituminous cement, then providing thereon a layer of stone elements coated with oil, and compacting the whole.

1,918,169. **Road Grader and Scarifier.** Franklin E. Arndt, Galion, O., assignor to The Galion Iron Works & Manufacturing Co., Galion, O. In a grading machine, the combination with a main frame, of draw bars connected to said main frame, a scraper mounted on said draw bars and operatively connected thereto for horizontal pivotal movement relative thereto, a scarifier carried by said draw bars in advance of the scraper, and thrust resisting members extending between the scarifier and the pivotal connection of said scraper to the draw bars.

JULY 18, 1933

1,918,336. **Pavement Marker.** Paul P. Horni, Newark, N. J. A pavement marker, comprising a head, a stem thereon having a wedge-shaped tip, a pair of wedge-shaped barbs located on opposite sides of said stem adjacent the tip thereof for displacing the material into which the marker is driven, and a second pair of wedge-shaped barbs located on opposite sides of the stem above the first pair of barbs and offset laterally on the stem with respect thereto for displacing the material laterally into the spaces formed by the first pair of barbs, the lower edges of said second pair of barbs terminating substantially in the plane of the upper edges of the first pair.

1,918,669. **Road Scraper.** Manuel C. Silva, Los Banos, Calif. A road scraper comprising a horizontal substantially U-shaped frame composed of spaced side members rigidly connected at their rear ends by a cross member, a scraper bowl having a rearwardly and upwardly extending handle and arranged between and pivoted at its ends to the free forward ends of the side frame members for free rotation within the frame upon a transverse axis, a transverse rod rigid with and connecting the side members of the frame intermediate their ends, a platform laid across and secured upon the rear cross members of the frame and said transverse rod, stub shafts rigid with and rising from the rear cross member of the frame near but spaced inwardly from the ends of the latter, brackets including sleeves journaled on said stub shafts and members rigid with and projecting rearwardly from said sleeves, ground engaging wheels journaled in the rear ends of said rearwardly projecting bracket members to support the rear end of the frame above the ground, and diagonally arranged inclined braces between the upper ends of said stub shafts and the side members of the frame.

1,918,710. **Road Paving Form.** Joseph H. Mosel, Lakewood, and Frank J. Schwemler, Shaker Heights, O., assignors to The Jaeger Machine Co., Columbus, O. In apparatus of the character described, the combination of a member having a base and a substantially upright side mold portion, said side mold portion having means thereon forming a pavement finishing guide, stake boxes secured to said base and said side mold portion, and a load carrying member extending parallel with said finishing guide and detachably supported on said stake boxes.

1,918,842. **Grading Frame.** Benjamin Franklin, Jr., Dresher, Pa. In combination, a trackless vehicle, a grading frame comprising a straight rotating shaft, impacting means on said shaft, a rigid member connected to the outer end of said shaft, and threaded means at the other end of said member whereby said shaft may be adapted to trim banks.